

THE REAL BOB ROBERTS™

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[9-11-01](#)

10/22/16..... We are temporarily closed... we are not taking any new orders or offering advice. We are completing all current transactions & receiving all outstanding payments till we are caught up. We will reopen as soon as possible. Sorry for any inconvenience this may cause. -- Bob & Alice



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For All Your Coin-Op Parts
The Real Bob Roberts™

What a mess!

I guess I really stepped into it back around 2000/1 when one of the hobbyist, Robert Jordan, put up a "shortcut" link called "TheRealBobRoberts.com" to my site to make it easier for all to find it. Now some 5 or 6 years later he has moved away from the hobby & has either let the domain name expire or sold it. Maybe I lasted longer then he expected... longer then I planned to be here for sure. After many emails about this that seem like they will continue past my time, I brought myself out of the Stone Age and looked into the repercussions of this. I found busted links all over the world pointing to "therealboroberts.com" ... a fine mess that I can now see :-(

After months of wondering what to do about this I decided to register a couple domain names myself... which I should have done to start with. The following domain names are now mine & were the simplest solution I could come up with.

<http://www.TheRealBobRoberts.net>

<http://www.TheRealBobRoberts.org>

In doing it this way I thought it would make it easier for me to ask the favor of y'all of changing links you may have to my site by simply changing the .com to .net or .org.

The links above direct you to two copies of my site parked on different servers, so the chances of both being down at the same time are pretty slim.

Other ways to the site are;

<http://homearcade.org/BBBB/> Located on Tony Berry's property.

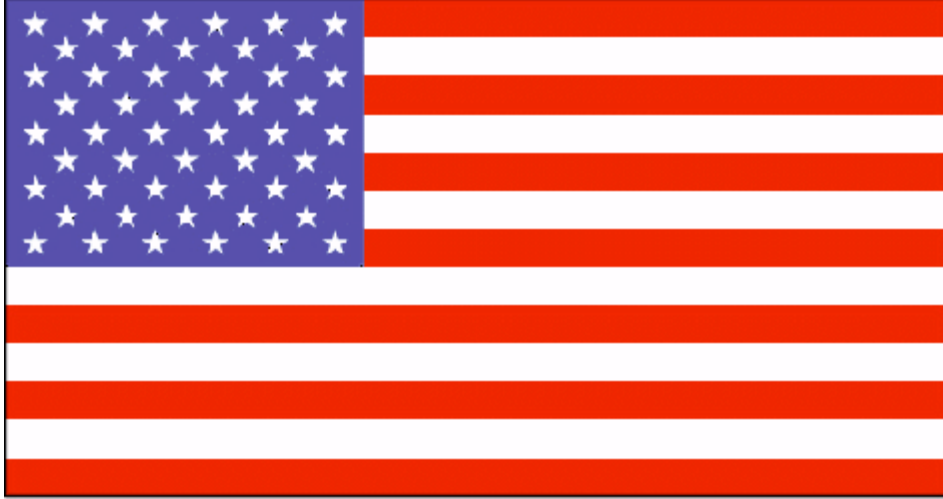
<http://arcadecontrols.com/BBBB/> A mirror thanks to John St Clair & Jason Presnell.

<http://personal.msy.bellsouth.net/~bob147> A window left open by Bellsouth upon migrating to Atlanta.

Commonly used links are also in the sig file of my emails, so any old correspondence from me should contain good links.

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Todd Beamer - Jeremy Glick - Thomas Burnett - Mark Bingham



Lest We Forget A Small Band of American Heroes

On Sale Now

Adaptors

These are links to pics of various types of adaptors and any that are for sale will have a price next to them. I've never liked the prefab adaptors that have been around for years. Most of them constrict the traces on one or more lines & do not allow you to ease the current draw as needed, so I've always made my own hardwire versions whereby I could control the adaptor rather than adjusting the power supply everytime that a board was changed and I like having a completely repairable adaptor should something ever go wrong with it. Being able to control I/O lines easily is another plus to them,e.g., the pads that need to be toggled low for cocktail cab use, or in simply rerouting power lines to points that really need them, such as with the Galaga where not only is the edge connector fed with 5 volts, but the video bd & CPU boost connector are fed, also.

The most important thing to remember when making your own adaptors is to start with a plain fingerboard that utilizes wide traces. You don't want to start off with idiotproofed fingerboards that are labeled on-board when etched because they put restrictions on all current paths. If you want the positions numbered or a pinout right on the fingerbd to idiotproof it, do it with white adhesive tape, or just plain scotch tape, and a fine point Sharpie & after it is finished & tested you can remove it. You need to avoid same side boards... ones where all your wires will go on the top side... for the same reason of trace restriction and this type also usually has circular pads to solder the wires to, another thing to avoid. Back in the 80's these were used in gray area gaming machines & the trouble with them was that the circular pads give you a place to start peeling the trace off the board in addition to being a current limiter. Same side with pads all on one side made the harness act as a handle to just rip up & away from the board... which happened frequently on the dark locations that these machines were set on.

All our adaptors are from classic board to the newer, better JAMMA wiring standard. We do not make, sell or recommend any JAMMA board to older, well-used classic wiring harness adaptors. Jamma to classic cab with DC power, such as a Jamma to Galaga adaptor, are alright for simply testing a Jamma bd in the cab once in a while, but for permanent use of a Jamma bd it is best to wire Jamma complete on a vacant wall thus preserving the classic intact, while being able to play any of the Jamma game bds.

1/25/15

Our harness maker has been inundated for the last three months with all the custom pieces... harnesses, adaptors, ribbon cables & such & we have been forced to bump pieces to the front of the line when payment has been received... out of normal order of first come first serve. We have been continuing the struggle trying to get back on track without much success. Another hindrance is people ordering specific harnesses, or adaptors, & then backing out when they find their pcb is fried, cab unsalvageable or just not worth their effort to continue with the restoration. All the time spent on these pieces just detracts from available time in making the things you do want. As a result of this, at least temporarily, all custom pieces will be made upon receipt of payment only.



Asteroids Adaptor



Bubble Bobble Jamma Adaptor

\$35.00



Clone Ms Pac-Man Jamma Adaptor

\$30.00



Crazy Climber Jamma Adaptor

\$35.00



Eprom Adaptor



Frogger Jamma Adaptor

\$35.00



Galaga Jamma Adaptor

\$40.00



Galaxian Jamma Adaptor

\$40.00



Ghost 'n Goblins Jamma Adaptor

\$40.00



Ghost 'n Goblins Jamma Adaptor



Hyper Sports Jamma Adaptor

\$35.00



Ikari Warriors Jamma Adaptor

\$35.00



Jamma Extension Adaptor

\$30.00



Konami Jamma Adaptor

\$35.00



Moon Patrol Jamma Adaptor

\$35.00



Mr Do Jamma Adaptor



Pacland Jamma Adaptor

\$40.00



Pac-Man / Ms Pac-Man Jamma Adaptor

\$50.00



Phoenix Jamma Adaptor

\$35.00



Rygar Jamma Adaptor



Rygar Jamma Adaptor

\$35.00



Sega Sys 16 Jamma Adaptor

\$40.00



SF2 Cab + Wiring To MK2 PCB + Adaptor

\$9.00



Super Pac-Man Jamma Adaptor

\$40.00



Track & Field Jamma Adaptor

\$35.00



V2000 Mon To G05-801 Wired Cabinet

\$20.00



G05-801 Mon To V2000 Wired Cabinet

\$20.00

Happy Gaming.....

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Coin-op Parts



Partial List

10/22/16..... We are temporarily closed... we are not taking any new orders or offering advice. We are completing all current transactions & receiving all outstanding payments till we are caught up. We will reopen as soon as possible. Sorry for any inconvenience this may cause.

--

Bob & Alice

The list below is some of the most commonly asked for parts.

Base shipping via USPS Priority in the USA is \$7.00.

We no longer ship outside the USA other than to Canada at a base fee of \$10.00.

ALL SALES FINAL
(: (Sorry, no CCs or PayPal):)



Absolutely, under no circumstances, use PayPal for your transactions.

I am not responsible for losses incurred if you try to do so.

May 1, 2013... We are saying good-bye to Happ after 27 years.

We are discontinuing sales of Happ products, so when stock on-hand is gone it will not be restocked. These items are sold on numerous other sites & with prices escalating every time we reorder we really cannot save you any money negating the need for us to supply these items.

This Page
Updated 6/12/2016

[Security Torx Bits & Handle Special \\$7](#)

Several of the newbies have asked me for my
Bad Trader List & it is now here.

It's a [BIG ONE!](#)

ON SALE
[Current Sale Items](#)

1/24/15

Handling a couple hundred emails a day with 13 to 15 being add-ons or changes to previous orders has resulted in many errors & proven to be too much for us old folks to handle. In the future we will not accept any changes to your original

order once placed. Double checking on your end is much easier than us trying to change a dozen orders in the middle of a pull & wrap session each day.

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Item	Price	Closeout
Electrohome GO7 Flyback transformer Reduced	\$25.00	
Electrohome GO7 Repair Kit	\$33.00	
G07 Super Repair Kit NEW	\$42.00	
G07 Deluxe Repair Kit NEW	\$45.00	
GO7 Electrohome Width Coil	\$10.00	
GO7-CBO 19" Cap Kit	\$7.00	
GO7-FBO 13" Cap Kit	\$6.00	
GO7 HOT 2SD870 /1	\$5.00	
GO7 XO4 2SC1106	\$5.00	
GO7 R908 47K ohms 1/2 watt 4 pk	\$1.00	
GO7 FR401 68ohms 2watt	\$1.00	
GO7 R902 7W2 ohm resistor	\$2.00	
1A Replacement Circuit Breaker	\$2.50	
3A Replacement Circuit Breaker	\$2.50	
5A Replacement Circuit Breaker	\$2.50	
10A Replacement Circuit Breaker	\$2.50	
15A Replacement Circuit Breaker	\$3.00	
20A Replacement Circuit Breaker	\$3.50	
25A Replacement Circuit Breaker	\$3.50	
Fuses Are Sold In Packs Of Five - Not Singles		
20mm PC Type A Fuse Clips 4/	\$1.00	
20mm PC Type B Fuse Clips 4/	\$1.00	
1.25" Standard Fuse Clips 4/	\$1.00	
Fuse Extraction Tool	\$3.00	
AC 3A fuse & holder	\$2.00	
AC Panel Mount Fuse Holder	\$2.00	
1.25PT mini fuses (5) Can Be Used For F901	\$4.00	
GO7 F901 1.5PT fuses (5)	\$5.00	
GO7 F902 3APT fuses (5)	\$5.00	
Standard 1 1/4" Type Fast Blow Fuses		
AGC-1/4A (250ma) 250volt fast blow fuse (5 pk)	\$2.50	
AGC-1/2A (500ma) 250volt fast blow fuse (5 pk)	\$2.50	
AGC-3/4A (750ma) 250volt fast blow fuse (5 pk)	\$2.50	
AGC-1A 250volt fast blow fuse (5 pk)	\$2.50	
AGC-2A 250volt fast blow fuse (5 pk)	\$2.50	
AGC-3A 250volt fast blow fuse (5 pk)	\$2.50	

AGC-4A 250volt fast blow fuse (5 pk)	\$2.50
AGC-5A 250volt fast blow fuse (5 pk)	\$2.50
AGC-6A 250volt fast blow fuse (5 pk)	\$2.50
AGC-7A 250volt fast blow fuse (5 pk)	\$2.50
AGC-8A 250volt fast blow fuse (5 pk)	\$2.50
AGC-10A 250volt fast blow fuse (5 pk)	\$2.50
AGC-15A 250volt fast blow fuse (5 pk)	\$2.50
AGC-20A 250volt fast blow fuse (5 pk)	\$2.50
Fuse Assortment Pack- Ten 5 packs of Fast Blow	\$15.00
Standard 1 1/4" Type Slow Blow Fuses	
MDL-0.25A (250ma) 250volt slow blow fuse (5 pk)	\$6.00
MDL-0.375A (375ma) 250volt slow blow fuse (5 pk)	\$6.00
MDL-0.5A (500ma) 250volt slow blow fuse (5 pk)	\$6.00
MDL-0.75A (750ma) 250volt slow blow fuse (5 pk)	\$6.00
MDL-1A 250volt slow blow fuse (5 pk)	\$5.00
MDL-1.5A 250volt slow blow fuse (5 pk)	\$5.00
MDL-2A 250volt slow blow fuse (5 pk)	\$6.00
MDL-2.5A 250volt slow blow fuse (5 pk)	\$5.00
MDL-3A 250volt slow blow fuse (5 pk)	\$5.00
MDL-4A 250volt slow blow fuse (5 pk)	\$5.00
MDL-5A 250volt slow blow fuse (5 pk)	\$5.00
MDL-6A 250volt slow blow fuse (5 pk)	\$5.00
MDL-6.25A 250volt slow blow fuse (5 pk)	\$6.00
MDL-7A 250volt slow blow fuse (5 pk)	\$6.00
MDL-8A 250volt slow blow fuse (5 pk)	\$6.00
MDL-10A 32volt slow blow fuse (5 pk)	\$6.00
MDL-15A 32volt slow blow fuse (5 pk)	\$7.00
MDL-20A 32volt slow blow fuse (5 pk)	\$8.00
MDL-25A 32volt slow blow fuse (5 pk)	\$10.00
Fuse Kit - 40 Common MDLs + 10 Common Pigtails	\$35.00
Small 20MM Type Fuses	
300MA 20MM [20EZ Chassis] (5 pk)	\$4.00
250MA (1/4A) 20MM Fuse 5 Pack	\$2.50
500MA (1/2A) 20MM Fuse 5 Pack	\$2.50
1A 20MM Fuse 5 Pack	\$2.50
1.25A 20MM Fuse 5 Pack	\$2.50
1.75A 20MM Fuse 5 Pack	\$2.50
2A 20MM Fuse 5 Pack	\$2.50
3A 20MM Fuse 5 Pack	\$2.50
4A 20MM Fuse 5 Pack	\$2.50

5A 20MM Fuse 5 Pack	\$2.50
6A 20MM Fuse 5 Pack	\$2.50
8A 20MM Fuse 5 Pack	\$2.50
10A 20MM Fuse 5 Pack	\$2.50
20A 20MM Fuse 5 Pack	\$2.50
250MA (1/4A) 1.25" FB Fuse 5 Pack	\$2.50
750MA (3/4A) 1.25" FB Fuse 5 Pack	\$2.50
1.5APT 20MM Fuse 5 Pack	\$5.00
2.25APT 20MM Fuse 5 Pack	\$5.00
3APT 20MM Fuse 5 Pack	\$4.00
4APT 20MM Fuse 5 Pack	\$4.00
4.5APT 20MM Fuse 5 Pack	\$4.00
5APT 20MM Fuse 5 Pack	\$4.00
3APT 1.25" Fuse 5 Pack	\$4.00
2 Amp Pico Fuse- Single Fuse	\$1.00
8AG 1/4 Amp 1" Fuse Bally Solenoid Bd- Single Fuse	\$2.00
Circuit Breaker Tester - Save Your Fuses	\$5.00
WG K7000 Flyback Replacement	\$25.00
WG K7000 Flyback Repair Kit	\$33.00
WG K7000 Horizontal width coil 009A2854-001	NLA
WG K7000 HOT 2SD1398	\$5.00
WG K7000 Regulator IC4 STR3123	\$5.00
WG K7000 Regulator IC4 STR30123 [1776]	\$5.00
WG K7000 Regulator IC4 STR3130 [1742]	\$5.00
WG K7000 Regulator IC4 STR30130 [1777]	\$5.00
WG K7000 Retrace Cap(Cap C36) PP 6100pf 1500v New Batch Found!!	\$7.00
WG K7000 Capacitor 3600pf 1500v	\$6.00
WG K7000 Capacitor C38 .39uf 200v	\$5.00
WG K7000 C51 Tantalum Cap	\$1.00
WG K7000 IC1 UPC1397	\$10.00
WG K7000 IC2 LA7823	\$6.00
WG K7000 IC3 UPC1378	\$11.00
WG K7000 R103 2.7 Ohm 7W Resistor	\$2.00
WG K4900 Horizontal width coil	NLA
Various lamp holders Price Each	\$1.50
Short Bayonet Lamp Holder	\$1.50
Tall Bayonet Lamp Socket	\$1.50
Coinco Coin Doors, Others & Pinball Machines	\$1.50
Wedge Lamp Holder Leaded	\$1.50
Bag of Ten Wedge Twist In Lamp Holders	\$5.00
Lamps Below Are Packaged In Lots Of 10 - No Singles Available	

Lamp Selection Help		
10 Lamps 44 Bayonet (twist in) 6Volt	\$2.00	
10 Lamps 47 Bayonet 6V	\$2.00	
10 Lamps 555 Wedge (push in) 6V	\$2.00	
10 Lamps 1813 (1815) Bayonet 12V	\$3.00	
10 Lamps 161 (194) Wedge 12V	\$3.00	
10 Lamps 51 Bayonet 6V (older pop bumpers)	\$3.50	Sold Out
10 Lamps 55 [GE 55 Bulk 100/\$20] Bingo Lamps 7V	\$2.50	Sold Out
10 Lamps 89 Bayonet 13V	\$3.50	
10 Lamps 906 Wedge 13V	\$3.50	
10 Lamps 912 Wedge 12.8V	\$3.50	
10 Lamps 2182 wire 14V	\$3.50	
10 Lamps 1458/1464 Bayonet 21V Bingo	\$5.00	Sold Out
10 Lamps 7381 Bi-Pin Ceramics 6.3V	\$10.00	Sold Out
5 Volt Indicator Lamp	\$1.00	
4 Lamps 4C7 Clear 120V/4W Cranes	\$2.00	Sold Out
4 Lamps 7C7 Frost 120V/7W Cranes	\$2.00	Sold Out
4 Lamps 40A15 Appliance Clear 120V/40W	\$3.00	
Nintendo Marquee Lamp Starter	\$5.00	
Nintendo Marquee Lamp	\$4.00	
Nintendo Marquee Lamp & Starter Together	\$8.00	
18" Open Fluorescent Fixture	\$11.00	Sold Out
18" Fluorescent Fixture	\$15.00	
18" Replacement Fluorescent Fixture	\$10.00	
18" Fluorescent lamps (tubes)	\$3.00	
Ballast for above 14w-20w	\$7.50	
Ballast 30 - 40 watt	\$10.00	
FS-2 Starter	\$1.00	
FS-25 Starter	\$1.00	
Starter replacement socket	\$2.00	
Clip In Starter Socket	\$2.50	
Fluorescent lamp replacement socket 2/	\$2.50	
¼ watt resistors 4 for	\$1.00	
½ watt resistors 4 for	\$1.00	
1 watt resistors 2 for	\$1.00	

2 watt resistors 2 for	\$1.00
2 watt 1.2 ohm resistor	\$1.00
2 watt 1.5 ohm resistor	\$1.00
2 watt 1.8 ohm cement resistors 2 for	\$1.00
2 watt 3.9 ohm Flameproof 5% Tolerance resistor	\$1.00
3 watt 3.6 ohm cement resistors 2 for	\$1.00
3 watt 120 ohm Flameproof 5% Tolerance resistor	\$1.00
5 watt resistor 0.1 ohm	\$1.00
5 watt resistor 0.5 ohm	\$1.00
5 watt resistor 1 ohm	\$1.00
5 watt resistor 1.2 ohm	\$1.00
5 watt 1.3 ohm resistor	\$1.00
5 watt resistor 1.75 ohm	\$1.00
5 watt resistor 2.2 ohm	\$1.00
5 watt resistor 3.9 ohm	\$1.00
5 watt resistor 4 ohm	\$1.00
5 watt resistor 5 ohm	\$1.00
5 watt resistor 10 ohm	\$1.00
5 watt resistor 20 ohm	\$1.00
5 watt resistor 22 ohm	\$1.00
5 watt resistor 27 ohm	\$1.00
5 watt resistor 33 ohm	\$1.00
5 watt resistor 50 ohm	\$1.00
5 watt resistor 75 ohm	\$1.00
5 watt resistor 100 ohm	\$1.00
5 watt resistor 150 ohm	\$1.00
5 watt resistor 1K ohm	\$1.00
5 watt resistor 1.3K ohm	\$1.00
5 watt resistor 2K ohm	\$1.00
5 watt resistor 5K ohm	\$1.00
5 watt resistor 8.2K ohm	\$1.00
5 watt resistor 10K ohm	\$1.00
7 watt 1.5 ohm resistor	\$1.00
7 watt resistor 2.7 ohm K7000 R103	\$2.00
7 watt resistor 2.7 ohm stand up G07 R902	\$2.00
7 watt resistor 470 ohm	\$1.00
10 watt resistor 1.5 ohm NI (Non-Inductive)	\$3.00
10 watt resistor 2 ohm	\$1.00
10 watt resistor 3 ohm	\$1.00
10 watt resistor 4 ohm	\$1.00

10 watt resistor 5 ohm	\$1.00
10 watt resistor 10 ohm	\$1.00
10 watt resistor 15 ohm	\$1.00
10 watt resistor 22 ohm	\$1.00
10 watt resistor 24 ohm	\$1.00
10 watt resistor 50 ohm	\$1.00
10 watt resistor 100 ohm	\$1.00
10 watt resistor 200 ohm	\$1.00
10 watt resistor 220 ohm	\$1.00
10 watt resistor 330 ohm	\$1.00
10 watt resistor 390 ohm	\$1.00
10 watt resistor 600 ohm	\$1.00
10 watt resistor 1K ohm	\$1.00
10 watt resistor 5K ohm	\$1.00
10 watt resistor 10K ohm	\$1.00
10 watt resistor 30K ohm	\$1.00
15 watt resistor .5 ohm	\$1.00
15 watt 3.9 ohm cement WW resistor	\$2.00
15 watt 220 ohm cement WW resistor (K7000)	\$1.00
15 watt 30K ohm cement WW resistor	\$2.00
25 watt 180 ohm cement WW resistor (20EZ)	\$2.00
25 watt 220 ohm cement WW resistor (G07)	\$2.00
4.7Kohm x 9 SIP resistor pack (10 leads)	\$1.00
SIP resistor pack - 470 - 1K - 2.2K - 4.7K	\$1.00
SIP Kit 50 Popular SIPs	\$25.00
Pots-Pots-Pots	\$1&Up
Atari 50 Ohm Volume Pot	\$32.00
Knob #1 For Above Atari Pot	\$4.00
Knob #2 For Above Atari Pot	\$3.00
Knob #3 For Above Atari Pot	\$2.00
Knob #4 w Allen Wrench For Above Atari Pot	\$4.00
10k Sealed Pot	\$5.00
Volume Pot 100 Ohm	\$2.00
Midway Volume Pot 50K Ohm	\$2.00
Williams Volume Pot 5K Ohm	\$2.00
WG Horizontal Type Pot for K7200 remote bds	\$1.00
G05-801 Deflection Bd Replacement Pot Kit (6)	\$9.00
G05-802 Deflection Bd Replacement Pot Kit (6)	\$9.00
V2000 Deflection Bd Replacement Pot Kit (4)	\$6.00
Amplifone 10K Long Lead Pot Pair	\$5.00

K7000 On-Board Replacement Pot Kit (7)	\$7.00
K7000 Remote Bd Replacement Pot Kit (6)	\$12.00
K7200 P832 Remote Bd Replacement Pot Kit (6)	\$6.00
K7400/U2000 Remote Bd Replacement Pot Kit (7)	\$7.00
G07 Replacement Pot Kit (4)	\$4.00
G07 Replacement Neck Bd Pot Kit	\$5.00
20EZ Replacement Pot Kit (5)	\$5.00
20-Z2AW Replacement Pot Kit (5)	\$7.00
20EZ Neck Board Replacement Pot Kit (5)	\$5.00
20EZ Replacement B+ Pot	\$1.00
20EZ Replacement H-Hold Pot	\$5.00
Nintendo DK Replacement Pot 30K Ohm	\$2.50
Nintendo DK Replacement Pot 50K Ohm	\$2.50
Nintendo DK Replacement Pot Pair 30K Ohm (2)	\$4.00
Nintendo DK Replacement Pot Pair 50K Ohm (2)	\$4.00
10' Nintendo AC Line Cord	\$8.00
Stern HV Pot	\$2.00
Bally 25K HV Pot	\$2.00
Bally 10K Sound Module Pot	\$2.00
Bally 1K Sound Module Pot	\$2.00
Bally 1K Squawk & Talk Pot	\$2.00
Midway Linear Power Supply 100 Ohm Pot	\$1.00
Midway Linear Power Supply 500 Ohm Pot	\$1.00
Atari Tempest PCB Replacement Pot Kit (8)	\$12.00
Can Type B+ filter	\$12.50
100uf450v B+ filter	\$4.00
150uf200v B+ filter	\$4.00
150uf450v B+ filter	\$4.00
180uf450v B+ filter	\$4.00
220uf250v B+ filter	\$4.00
220uf350v B+ filter	\$4.00
220uf400v B+ filter	\$4.00
330uf200v B+ filter	\$4.00
330uf250v B+ filter	\$4.00
330uf400v B+ filter	\$4.00
390uf200v B+ filter	\$4.00
470uf200v B+ filter	\$4.00
470uf250v B+ filter	\$4.00
470uf250v B+ Filter	\$4.00
470uf400v B+ filter	\$4.00

560uf200v B+ filter	\$4.00
560uf400v B+ filter	\$4.00
680uf200v B+ filter	\$4.00
820uf200v B+ filter	\$4.00
1000uf100v B+ filter	\$4.00
1500uf200v B+ filter	\$4.00
2200uf80v B+ filter	\$4.00
2100uf75volt CG cap 1 3/8" D x 3"	\$5.00
2200uf50volt CG cap 1 3/8" D x 2¼"	\$5.00
7200uf50volt CG cap 1 3/8" D x 4" G05-801	\$12.00
12Kuf25volt CG cap 1 3/8" D x 2"	\$9.00
12Kuf25volt Kit	\$10.00
16kuf15volt CG cap 1 3/8" D x 5"	\$5.00
17kuf35volt CG cap 1 3/8" D x 5½"	\$5.00
20kuf15volt CG cap 1 3/8" D x 4¼"	\$5.00
28kuf25volt CG cap 2" D x 3"	\$12.50
55kuf25volt CG cap 2 1/2" D x 3" Factory Fresh Batch In Stock Now 56K	\$15.00
100kuf16volt CG cap 2 1/2" D x 3" Factory Fresh Batch In Stock Now	\$20.00
QD Kit For Above CG Caps (Kickman & Others)	\$2.00
Radial Cap Ten Packs	
Axial Cap Ten Packs	
22uf400volt Radial Leads	\$1.00
33uf400volt Radial Leads	\$1.00
220uf160volt Radial Leads Reduced	\$2.50
330uf160volt Radial Leads Reduced	\$2.50
470uf160volt Radial Leads Reduced	\$2.50
1500uf16volt Radial Leads	\$1.00
1500uf63volt Radial Leads	\$2.00
2200uf10volt Radial Leads 4/	\$1.00
2200uf100volt Radial Leads	\$5.00
4700uf50volt Radial Leads	\$5.00
8200uf50volt radial precuts w stabalizer	\$6.00
10,000uf25v Radial Leaded Fresh Nichicon	\$3.00
10,000uf50v Radial Leads Fresh Nichicon	\$5.00
47uf100volt axial	\$1.00
100uf100volt axial	\$1.00
100uf160volt axial	\$2.00
150uf250volt axial	\$5.00
150uf350volt axial	\$5.00

250uf50volt axial	\$1.00
470uf35volt axial	\$1.00
1000uf10volt axial	\$1.00
1000uf50volt axial	\$1.00
2200uf50volt axial	\$2.50
3300uf35volt axial	\$4.00
4700uf25volt axial	\$3.50
4700uf35volt axial	\$4.00
6800uf35volt axial	\$6.00
10,000uf10volt axial	\$2.50
10,000uf16volt axial	\$3.00
10,000uf35volt axial	\$5.50
18,000uf25volt axial (Williams Linear Power Supply)	\$6.00
22,000uf35volt axial	\$7.00
4700uf50volt radial for XY monitors	\$5.00
6800uf50volt radial for XY monitors	\$5.00
6800uf80volt radial	\$5.00
10,000uf35v radial - can easily replace axial	\$6.00
10,000uf50v radial - can easily replace axial	\$6.00
15,000uf25v radial - can easily replace axial	\$6.00
18,000uf35v radial - can easily replace axial	\$6.00
22,000uf16v radial - can easily replace axial	\$6.00
22,000uf25v radial - can easily replace axial	\$6.00
4700uf50volt can type cap common in jukebox	\$7.00
Electrolytic monitor caps individually from	\$1.00
.68uf35volt Tantalum Cap (K7000 C51)	\$1.00
4.7uf25volt Tantalum Cap	\$1.00
10uf25volt Tantalum Cap	\$1.00
1uf50volt NP Radial Cap	\$1.00
1uf100volt NP Radial Cap	\$1.00
2.2uf50volt NP Radial Cap	\$1.00
3.3uf50volt NP Radial Cap	\$1.00
4.7uf50volt NP Radial Cap	\$1.00
5.6uf50volt NP Axial Cap	\$1.00
5.6uf50volt NP Radial Cap	\$1.00
10uf50volt NP Radial Cap	\$1.00
22uf50volt NP Radial Cap	\$1.00
100uf25volt NP Radial Cap	\$1.00
330uf25volt NP Radial Cap	\$1.00
4.7uf50volt BP High Frequency Radial Cap	\$2.00

6.8uf50volt BP High Frequency Radial Cap	\$2.00
8.2uf50volt BP High Frequency Radial Cap	\$2.00
10uf50volt BP High Frequency Radial Cap	\$2.00
Poly Caps each -Order by Value or Number	\$1.50
Disc & Mylar Caps 2 of same value for	\$1.00
.001uf25,000volt High Voltage Ceramic Disk (1000pf)	\$3.00
Orange Drop Caps Choice .0068/1200v or .0033/1600v	\$1.50
5 Pack of 100pf1kv disc caps	\$1.00
.1uf 5.5v Cap	\$3.00
1uf 5.5v Cap	\$5.00
3600pf1600v polypro cap	\$6.00
6100pf1600volt cap	\$7.00
.015uf400volt cap	\$1.00
.047uf400volt cap	\$1.00
.15uf200volt cap	\$1.00
.39uf200volt WG cap	\$5.00
.47uf250volt cap	\$1.00
Crystal or Clock Oscillator	\$2.50
LED PCB Power Indicator 2/	\$1.00
1N914 5 for	\$1.00
1N4003 [200 Volt 1N4001 thru 1N4003] 20 for	\$1.00
1N4007 (1N4001 thru 1N4007) 5 for	\$1.00
1N4148 4 for	\$1.00
1N4148 Special 20 for	\$1.00
1N4729 3.6 volt zener diode 2 for	\$1.00
1N4730 3.9 volt zener diode 2 for	\$1.00
1N4731 4.3 volt zener diode 2 for	\$1.00
1N4732 4.7 volt zener diode 2 for	\$1.00
1N4733 5.1 volt zener diode 2 for	\$1.00
1N4734 5.6 volt zener diode 2 for	\$1.00
1N4735 6.2 volt zener diode 2 for	\$1.00
1N4736 6.8 volt zener diode 2 for	\$1.00
1N4737 7.5 volt zener diode 2 for	\$1.00
1N4738 8.2 volt zener diode 2 for	\$1.00
1N4739 9.1 volt zener diode 2 for	\$1.00
1N4740 10 volt zener diode 2 for	\$1.00
1N4742 12 volt zener diode 2 for	\$1.00
1N4743 13 volt zener diode 2 for	\$1.00
1N4745 16 volt zener diode 2 for	\$1.00
1N4746 18 volt zener diode 2 for	\$1.00

1N4749 24 volt zener diode 2 for	\$1.00
1N4750 27 volt zener diode 2 for	\$1.00
1N4757 51 volt zener diode 2 for	\$1.00
1N4758 56 volt zener diode 2 for	\$1.00
1N4759 62 volt zener diode	\$1.00
1N4760 68 volt zener diode	\$1.00
1N4763 91 volt zener diode	\$1.00
1N4764 100volt zener diode	\$1.00
1S4121 125 volt zener diode	\$1.00
1N5275B 140 volt zener diode	\$2.00
1.5 Watt 150 volt zener diode	\$2.50
1N5335B 5 watt 3.9 volt zener diode	\$2.00
1N5342B 5 watt 6.8 volt zener diode	\$2.00
1N5343B 5 watt 7.5 volt zener diode	\$2.00
1N5349B 5 watt 12 volt zener diode	\$2.00
1N5358B 5 watt 22 volt zener diode	\$1.00
1N5359B 5 watt 24 volt zener diode	\$1.00
1N5361B 5 watt 27 volt zener diode	\$2.00
1N5363B 5 watt 30 volt zener diode	\$3.00
1N5383B 5 watt 150 volt zener diode	\$3.00
1N5550 / 1N5551	\$1.00
1N4937 NTE 552	\$2.00
LM7805CV Voltage Regulator +5 volt 1.5A	\$1.00
LM7809CV Voltage Regulator +9 volt 1.5A	\$1.00
LM7812CV Voltage Regulator +12 volt 1.5A	\$1.00
LM7815CV Voltage Regulator +15 volt 1.5A	\$1.00
LM7818CV Voltage Regulator +18 volt 1.5A	\$1.00
LM7824CV Voltage Regulator +24 volt 1.5A	\$1.00
LM7905CV Voltage Regulator -5 volt 1.5A	\$1.00
LM7912CV Voltage Regulator -12 volt 1.5A	\$1.00
LM7915CV Voltage Regulator -15 volt 1.5A	\$1.00
LM7918CV Voltage Regulator -18 volt 1.5A	\$1.00
LM7924CV Voltage Regulator -24 volt 1.5A	\$1.00
Voltage Regulator Kit	\$10.00
1N5400 Diode (NTE 5800) 3 Amp 50V	\$1.00
1N5401 Diode (NTE 5801) 3 Amp 100V	\$1.00
1N5402 Diode (NTE 5802) 3 Amp 200V	\$1.00
1N5404 Diode (NTE 5804) 3 Amp 400V	\$1.00
1N5406 Diode (NTE 5806) 3 Amp 600V	\$1.00
1N5624 Diode (NTE 5802) 3 Amp 200V	\$1.00

1N5817 diode (NTE585)	\$1.00	
1N5990 sub 1N4730 (NTE 5067A) 2 for	\$1.00	
5A2 Diode 5 Amp 200V (NTE 116)	NLA	
6A1 Diode 6 Amp 100V	\$1.00	
6A4 Diode 6 Amp 400V	\$1.00	
6A10 Diode (NTE 5812) 6 Amp 100V	\$1.00	
6A20 Diode (NTE 5814) 6 Amp 200V	\$1.00	
FR106 Diode (NTE 558)	\$2.00	
FR156 diode (NTE 506)	\$1.00	
FR302 diode (NTE 580)	\$1.00	
GI851 Diode (NTE569)3A100V FR	\$1.00	
H1809 HV Diode (D903) V2000	\$15.00	Sold Out
H1812 HV Diode (D904) G05	\$15.00	Sold Out
P600G diode (NTE 5814) 6 Amp 400V	\$1.00	
RU4 3A200V FR	\$1.00	
SF-22 diode (NTE 588)	\$2.00	
AL156 Bridge Rectifier 1.5A 600V Pic 1 WMs BR3	\$1.00	
2KBP10 Bridge Rectifier 2A 1000V Pic 2 (WMs Snd Bd)	\$1.50	
KBU401 Bridge Rectifier 4A 100V Pic 2 WMs BR2	\$1.50	
KBPC-601 Bridge Rectifier 6A 100V Pic 5	\$1.50	
BR64 Bridge Rectifier 6A 50V-400V Pic 5 G05/Bally VJ248	\$2.00	
KBPC-802 Bridge Rectifier 8A 200V Pic 5	\$2.00	
KBPC-3502 Bridge Rectifier 35A 200V tabs Pic 7	\$3.00	
KBPC-3504 Bridge Rectifier 35A 400V tabs Pic 7	\$3.50	
KBPC-3506 Bridge Rectifier 35A 600V tabs Pic 7	\$4.00	
KBPC-3502W Bridge Rect - WMs BR1	\$3.50	
KBPC-3504W Bridge Rect	\$4.00	
KBPC-3506W Bridge Rect 35A 600V wire legs	\$4.50	
KBPC-3508W Bridge rectifier 35A 800V wire legs Pic 3	\$5.00	
2N2905	\$1.00	
Mica insulators (TO-3) 6/	\$1.00	
Mica insulators (TO-66) 6/	\$1.00	
Mica insulators (TO-220) 6/	\$1.00	
Mica insulators (Large) 2/	\$1.00	
Mica Insulator Kit (Large)	\$2.00	
Insulator & Mounting Kit	\$10.00	
2N3055	\$3.00	
2N3440 Bally solenoid bds	\$1.50	
2N3568	\$1.00	

2N3584 Bally solenoid bds	\$5.00
Mica insulators (TO-66) for above 6 for	\$1.00
2N3706	\$1.00
2N3711 (NTE199)	\$1.00
2N3716 [XY monitors]	\$3.50
2N3792 [XY monitors]	\$3.50
2N3772	\$3.50
Mica insulators (TO-3) for above 6 for	\$1.00
TO-3 Insulator/mounting Kits A-\$2.50 B-\$3.50 C-\$4.00	\$4.00
TO-66 Mounting Kit B Type	\$2.75
TO-66 Mounting Kit C Type	\$3.00
Heat sink compound 4g packet	\$2.00
Heat sink compound 1oz tube	\$5.00
Heat sink for TO3 xsistors	\$1.00
Heat sink for 2 TO-220 xsistors	\$1.00
2N3904 4 for	\$1.00
2N3906 4 for	\$1.00
2N4401 3 for	\$1.00
2N4403 3 for	\$1.00
2N5060 SCR .8A 25v \$1 ea or 10 for	\$5.00
2N5062 SCR .8A 100v \$1 ea or 10 for	\$5.00
2N5064 SCR .8A 200v \$1 ea or 10 for	\$5.00
2N5320	\$2.50
2N5322	\$2.50
2N5365 (NTE 290A) K4900 color	\$1.00
2N5401	\$1.00
2N5550	\$1.00
2N5551	\$1.00
2N5631 (NTE60)	\$5.00
2N5875	\$8.50
2N5876 Use sub 2N3792	\$3.50
2N5878 Use sub 2N3716	\$3.50
2N5879	\$8.50
2N6043	\$2.00
2N6050	\$5.00
2N6055	\$5.00
2N6057	\$5.00
2N6059	\$5.00
2N6107 [197] PNP driver	\$2.50
2N6122 Sub for Pac Q6	\$3.00

2N6236 (MCR106-1)	\$2.50	
2N6259 [388]	\$5.00	
2N6284 Rowe amps	\$5.00	
2N6287 Rowe amps	\$6.00	
2N6292 [196]	\$1.00	
2N6401	\$2.00	
2N6557	\$5.00	Sold Out
2SA-940	\$2.00	
2SA-1015 [290A]	\$1.00	
2SC454 [85] Sub 1815	\$1.00	
2SC1106 [162]	\$5.00	
2SC1114	\$5.00	
2SC1454	\$5.00	
2SC1507 Back In Stock 12/08	\$3.00	
2SC1514 (used on GO7 neckbd)	\$4.00	
2SC1569 (NTE376) K4900 neckbd	\$1.00	
2SC1685 [85] Sub 1815	\$1.00	
2SC1815 LF Amp (NTE85)	\$1.00	
2SC1845 GO7 X902	\$1.00	
2SC1942	\$5.00	
2SC2073 Used as vert outputs & more	\$3.00	
2SC2194	\$2.00	
2SC2365 [163A]	\$5.00	
2SC2482	\$2.00	
2SC2555 [2308]	\$4.00	
2SC2610	\$2.50	
2SC2611 Back In Stock 12/08	\$2.50	
2SC2688 GO7 X901	\$1.00	
2SC3039 switching power supplies	\$1.00	
2SC3042 [2308]	\$5.00	
Mica insulators (TO220) for above 6 for	\$1.00	
Heat sink compound 4g packet	\$2.00	
2SC3040 [2308]	\$3.50	
2SC3089	\$3.50	
2SC3152 [2348]	\$3.50	
2SC3153 [2309]	\$3.50	
2SC3451	\$3.75	
2SC3502 [2501]	\$2.00	
2SC3686 [2324]	\$5.00	
2SC3687 [2324]	\$7.00	

2SC3688 [2354]	\$8.00
2SC3782 [2507]	\$3.00
2SC3950 [2510]	\$2.00
2SC4542 [2354]	\$5.00
2SC4742 [2302]	\$4.00
2SC4769 [2353]	\$4.00
2SC5143 [2669]	\$5.00
2SC5144 [2661]	\$5.00
2SC5150 [2639]	\$5.00
2SC5297 [2324]	\$5.00
2SD478 [375]	\$2.50
2SD692 sub [243]	\$5.00
2SD869 Nintendo HOT	\$5.00
2SD870 [89]	\$5.00
2SD871 Various monitor HOTS Replaces 869 & 870	\$5.00
2SD880	\$5.00
2SD898B	\$5.00
2SD1090 20EZ Chassis	\$5.00
2SD1138 Various monitor vert outputs	\$3.50
2SD1294	\$3.50
2SD1398 [2302]	\$5.00
2SD1879 [2331]	\$5.00
2SD1887 [2354] Neotec HOT	\$5.00
2SK1358 [2377]	\$5.00
2SK2746 [2377]	\$5.00
2SK3568 [2911]	\$5.00
4N28	\$1.00
6N60	\$2.50
6N80	\$2.50
12N10L	\$2.50
13N10L	\$2.50
A15 diode - Pac series - sub	\$1.00
AM6012 DAC Fresh batch - dip case(AD brand)	\$11.00
Amplifone Q3 BU406D	\$4.50
AY-3-8910	\$9.00
AY-3-8912	\$9.00
BT-136 - 500 [5609]	\$1.25
BT-137 - 800E [5610]	\$2.50
BT-138 - 600F [56008]	\$3.00
BT-151 - 500R [5499]	\$3.00

BU207 sub	\$5.00
BU208	\$5.00
BU208A [165]	\$5.00
BU208D - can sub 2SD869/70/71	\$5.00
BU2532AL [2533]	\$5.00
BU406	\$1.50
BU406 with a HV FR damper diode	\$2.50
BU406D New Batch 1/23/2015	\$4.50
BU407	\$2.00
BU407D	\$4.50
BU409 sub	\$2.00
BU508A [2300]	\$5.00
BDW83C NSM	\$5.00
BDW84C NSM	\$5.00
BDW8300 NSM thermal control	\$8.00
BDX53 Back in stock at nearly half the price	\$5.00
BY-133 HV FR 2 amp 1400v diode	\$1.00
CA3081N <>Just A Few Hundred Left From May Batch<>	\$3.00
CD4011	\$1.00
CD4016	\$1.00
CD4066	\$1.00
CD4071	\$1.00
Other CD Series Here	\$1 & Up
CD4502	\$1.00
C012294 Atari Pokey	\$15.00
C012294 Atari Pokey Machine Socketed New Pulls	\$9.00
D1402 [2300]Horizontal Output Transistor NPN	\$5.00
D40K1 Used on Pac Bds	\$5.00
D780C-1 CPU 4MHZ	\$4.50
DAC08	\$3.00
DAC312 Plastic dip digital/analog converter	\$11.00
DG201A Quad JFET analog switch (Tempest)	\$5.00
DT230b FS Diode sub for D506 19V2000	\$1.00
ER2055 New Source - Over 50% Less	\$4.00
ECG/ERS 121	\$5.00
FQPF6N80C	\$2.50
FR106 Diode (NTE 558)	\$2.00
FR156 diode (NTE 506)	\$1.00
FR302 Diode (xref ECG580)	\$1.00
GI851 Diode (NTE569)3A100V FR	\$1.00

H11C3	\$1.00	
H11J3	\$1.00	
4N25	\$1.00	
4N26	\$1.00	
4N28	\$1.00	
4N32	\$1.00	
4N33	\$1.00	
4N35	\$1.00	
6N60	\$2.50	
6N80	\$2.50	
12N10	\$2.50	
H1809 HV Diode (D903)	\$15.00	Sold Out
H1812 HV Diode (D904)	\$15.00	Sold Out
HA11235	\$5.00	
HA11244	\$10.00	
HA13118	\$5.00	
HA11423	\$5.00	
HA17458	\$2.00	
IRF540 N-Channel Mosfet	\$1.00	
IRL540 N-Channel Mosfet	\$2.00	
KA3842B	\$5.00	
LA4460N	\$5.00	
LA5112N Sanyo 20EZ Regulator Fresh Batch 7/7/14	\$5.00	
LA7823	\$6.00	
LA7824	\$4.00	
LA7830	\$4.00	
LA7831	\$5.00	
LA7833	\$5.00	
LA7850	\$4.00	
LA7851	\$4.00	
LF13001	\$7.50	
LF13201N Quad JFET analog switch	\$5.00	
LM1458	\$2.00	
LM2878P	\$20.00	
LM305 Atari audio/regulator bds - USE SUB BELOW Same Regulator - Different Manufacturer	\$8.50	
LM305 Sub Used By Atari - Midway - Many Other Mfrs	\$5.00	
LM311V	\$2.50	
LM317AT [956] With Heat Sink	\$2.00	

LM317T [956] TO220	\$1.00
LM317K [970] TO3	\$4.00
LM323K	\$5.00
LM324	\$1.00
LM3302	\$5.00
LM337T	\$1.00
LM338K	\$5.00
LM339N	\$1.00
LM359N	\$2.50
LM348N	\$1.00
LM377	\$4.00
LM379S New Lot 7/09	\$12.00
LM380N	\$1.25
LM380N-8	\$1.25
LM381N	\$2.00
LM393	\$2.00
LM555N	\$1.00
LM556N	\$2.00
LM723 Used in WMs OEM PSs	\$1.00
LM741	\$1.00
LM833N	\$2.00
LM1203N National RGB	\$8.00
LM1458	\$2.00
LM1877 Pac sound	\$4.00
LM3900 Nintendo & others audio	\$2.00
LM7805CV Voltage Regulator +5 volt 1.5A	\$1.00
LM7809CV Voltage Regulator +9 volt 1.5A	\$1.00
LM7812CV Voltage Regulator +12 volt 1.5A	\$1.00
LM7815CV Voltage Regulator +15 volt 1.5A	\$1.00
LM7818CV Voltage Regulator +18 volt 1.5A	\$1.00
LM7824CV Voltage Regulator +24 volt 1.5A	\$1.00
LM7905CV Voltage Regulator -5 volt 1.5A	\$1.00
LM7912CV Voltage Regulator -12 volt 1.5A	\$1.00
LM7915CV Voltage Regulator -15 volt 1.5A	\$1.00
LM7918CV Voltage Regulator -18 volt 1.5A	\$1.00
LM7924CV Voltage Regulator -24 volt 1.5A	\$1.00
M51516L Various mfrs used these	\$10.00
M58725P Ram	\$5.00
MB3712 Midway sound	\$9.50
MB3713 Atari sound	\$6.00

MB3730 New Batch Found Mar 07 - Lower Price	\$8.00
MB3731	\$12.00
MB3733	\$6.50
MC1408L6	\$2.00
MC1408P8	\$3.00
MC1495 (SG1495)	\$12.00
MC14514 / CD4514 Back in Stock	\$2.00
MC14174B	\$2.00
MC14543	\$2.50
MC14572	\$1.00
MC14584	\$1.00
MC3459	\$6.00
MCR68-1 (Sub)	\$5.00
MCR100-4	\$1.00
MCR100-6	\$1.00
MCR106-1 (C106M)	\$1.00
MJE15030 (NTE 54)	\$2.00
MJE15031 (NTE 55)	\$2.00
MJE2955T (NTE 332)	\$2.00
MJE340 (NTE 157)	\$2.00
MJE350 (NTE 39)	\$1.00
MK 4027N Ram	\$2.50
MPSA06 precuts 10 for	\$1.00
MPSA06 long leads 2 for	\$1.00
MPSA13 2 for	\$1.00
MPSA42 2 for	\$1.00
MPSA56 2 for	\$1.00
MPSA70	\$2.00
MPSU03 - NTE190 equivalent	\$3.00
MPSU07 - XY Deflection bds TO-202N Pkg	\$15.00
MPS-U07 - TO-202 Heavy Duty Pkg	\$5.00
MPSU10	Sold Out
MPSU45 - sub heavy duty NTE272	\$2.75
MPSU57 - XY Deflection bds TO-202N Pkg	\$5.00
MPS-U57 - TO-202 Heavy Duty Pkg	\$5.00
MR-501 Pac series diode	\$1.00
MR-751 [5812]	\$2.00
MUR1100 1 Amp 1000V Ultra-fast Diode 2/	\$1.00
NE5532	\$2.00
NTE 102	\$4.00

NTE 942 (LM381AN)	\$12.50
NTE 953 Pac UA78GU1C	\$12.50
NTE 981	\$5.00
NTE 1550	\$10.00
P600A Across Atari Big Blue Cap PCB (2 needed)2/	\$2.00
R1500F HV FR Diode	\$1.00
R2000F HV FR Diode	\$1.00
RS-202 In-line bridge 2A 200V	\$1.00
RU4 3A200V FR	\$1.00
S5A2 [5812]	\$2.00
SF22 Diode [588]	\$2.00
SK150V 150 volt zener diode	\$2.50
SSS6N60A	\$2.50
STR 381	\$5.50
STR 383	\$5.50
STR 3123	\$5.00
STR 3130	\$5.00
STR 30123	\$5.00
STR 30130	\$5.00
TA7405P	\$6.00
TDA 1670A	\$5.00
TDA 1675A	\$6.50
TDA 1771 WG U5000 vert IC	\$6.00
TDA 2002 Atari A/R bds & others sound	\$3.00
TDA 2003	\$3.00
TDA 2030	\$3.00
TDA 2593	\$5.00
TDA 2595	\$5.00
TDA 2653A	\$5.00
TDA 2822M	\$1.00
TDA 8172	\$5.00
TIC106	\$1.00
TIP29C \$1ea 10 for	\$7.50
TIP30 \$1ea 10 for	\$7.50
TIP30C \$1ea 10 for	\$7.50
TIP31C \$1ea 10 for	\$7.50
TIP32A \$1ea 10 for	\$7.50
TIP32C \$1ea 10 for	\$7.50
TIP36C (NTE393)	\$3.50
TIP42A (NTE197)	\$1.50

TIP42C (NTE332)	\$1.50	
TIP 102 Darlington Transistors (SE9302)\$1ea 10 for	\$7.50	
TIP 107 (NTE2344)\$1ea 10 for	\$7.50	
TIP115	\$1.00	
TIP 120 Darlington Transistors \$1ea 10 for	\$7.50	
TIP 122 Darlington Transistors \$1ea 10 for	\$7.50	
TIP125 (NTE262)	\$1.00	
TIP140 (NTE270)	\$2.00	
TIP141	\$2.00	
TIP146	\$2.00	
TIP 147 (NTE271)	\$2.50	
TIPL762	\$7.00	
TIS 98 sub(XY monitors)	\$1.00	
TL494CN switching power supplies	\$1.00	
TL497	\$5.00	
TLO81CP	\$1.00	
TLO82CP	\$1.00	
TMS34010FNL	\$15.00	
TMS5200	\$10.00	Sold Out
TMS5220	\$10.00	
TMS9928	\$12.50	Sold Out
TPS 98 sub	\$1.00	
UA78GU1C	\$10.00	
UC3842AN	\$5.00	
UDN 6118 Gottlieb Display Driver	\$6.00	
ULN 2003	\$1.00	
ULN2064	\$5.00	
ULN 2803	\$1.00	
UPC 1378 Reduced	\$6.00	
UPC 1397 K7000 IC1 Reduced	\$7.00	
UPC 1398	\$5.00	
UPC 1488H	\$6.50	
XR 4741	\$3.50	
Z80-CPU 2.5mhz	\$4.00	
Z80A-CPU 4mhz	\$4.50	
Z80B-CPU 6mhz	\$5.00	
Z80-CTC	\$3.00	
Solid Amp Dual Wipe 40 Pin IC Socket	\$1.00	
6502 1mhz	\$8.00	

6502A 2mhz	\$10.00	Sold Out
6502B 3mhz	\$12.00	
6502C 4mhz	\$0.00	
6522	\$4.00	
6532	\$9.00	
6800	\$7.00	
6802	\$10.00	
6808 USE 6802	\$10.00	
6809	\$4.50	
68B09EP 2mhz WMs Boards	\$8.50	
6810 Ram	\$4.00	
6821 PIA peripheral interface adaptor	\$7.50	
6840	\$4.00	
68xx IC Package	\$16.00	
74xx Series IC - Specify - From	\$1.00	
IC Sockets - Specify # Pins 2/ *Click for tube pricing*	\$1.00	
16 Pin ZIF IC Socket	\$2.25	
40 Pin ZIF IC Socket	\$3.00	
Need an IC socket with your IC? Add "plus socket"	\$0.50	
24/28 Pin IC Heatsink	\$1.00	
40/42 Pin IC Heatsink	\$1.00	
74LS399N	\$2.50	
74LS48N	\$4.00	
75176 Rowe CBA2 link chip	\$2.50	
75451	\$1.50	
75452	\$1.50	
75492	\$3.50	
76489	\$5.00	
8035	\$4.00	
8080A	\$7.00	
8085	\$5.00	
8255	\$5.00	
9602 Bally MPU U16 chip	\$2.50	
1408L6	\$3.00	
Rams--Rams--Rams		
2015/16/18 Ram Slimline w socket	\$4.00	
2016 Ram	\$3.00	
2063/4/88 Ram Slimline (CY7C185)	\$10.00	
2101 Ram	\$3.00	

2102 Ram	\$3.00	Sold Out
2107 Ram (SI,SID,Others) (5280/4060/9060/411/8107)	\$3.00	
Tube of 16 x 9060 Ram Above	\$32.00	
2114-2L Ram (AM91L14CDC) Pac 4K - 4R	\$3.75	
21C14 CMOS Ram	\$5.00	
2125 Pac series used at 2A/2B/2C/2D	\$5.00	
2125 Ram Pulls	\$3.00	
Heat Sinks For Above or any 14/16 Pin ICs \$1 ea or 4/	\$3.00	
2128 Ram	\$4.00	
2147 Ram - Back In Stock	\$6.00	
2148 Ram - Back In Stock	\$6.00	
27LS00 Ram (82S16/74S200) sub	\$5.00	
4016-20 TMS Replace 2016/2128/4802/6116/8128/9128/ Etc	\$4.00	
4027 Ram	\$2.50	
4045 Ram (TMS)	\$2.00	
4116 Ram 24 /\$24 150ns For WMs	\$1.25	
414256-70 [HY534256AS-70]	\$2.00	
41464 [D41464-C10]	\$2.00	
4164 Ram (Alt Mfrs 3764 - 4264 - 4864 - 8264 - 9064)	\$1.00	
4164 Ram x 24 Plus 4116 to 4164 Adaptor	\$35.00	
4464 [TMS 4464-12]	\$3.50	
4517 Ram (8118)	\$5.00	
50464 [HM 50464P-15]	\$3.00	
5101 Ram Will work in all coin-op machines	\$6.00	
5114 Ram (5514)(6514) CMOS	\$5.00	
51256 [M51C256-10]	\$3.00	
5280 Ram	\$5.00	
58725 Ram	\$5.00	
6116 Ram	\$4.00	
62256 Ram	\$4.00	
6064 Ram Alt 5165/5565/6264/8464/9988	\$3.00	
6810 Ram	\$4.00	
7489 Ram Pac series 2K/2L/3F/3H	\$5.00	
82S09 Ram	\$7.50	
82S16 Ram (27LS00/74S200) sub	\$5.00	
AM9101 Ram	\$3.00	
AM93422	\$6.00	
CY7C185 Ram Replaces 65764 slim line	\$10.00	
Custom Chips 00xx/04xx/07xx/11xx/12xx/51xx/56xx	\$20.00	
82S123 Prom AM27S19-MB7112-63S081-74S288	\$7.50	

82S126 Prom AM27S20-MB7113-63S140-74S387	\$7.50	Sold Out
82S129 Prom AM27S21-MB7114-63S141-74S287	\$7.50	
82S131 Prom AM27S13-MB7116-63S241-74S571	\$7.50	
82S137 Prom AM27S33-MB7122-63S441-74S573	\$7.50	
Proms above can be programmed with your supplied files. I do have approximately 6000 various verified ones on file.		
Below are clean factory eprom pulls starting at (Don't be surprised to find NOS mixed in, also)	\$2.00	
TMS2516 Use Std 2716	\$4.00	
TMS2716 Nonconforming	\$2.00	
2716 (New - Unused)	\$4.00	
2532 Programming help	\$5.00	
2732	\$4.00	
2764 (New-Unused)	\$4.00	
27128	\$3.00	
27256	\$4.00	
27512	\$3.00	
27010	\$4.00	
27020	\$5.00	
27040	\$6.00	
27080	Out	
27C4096	\$7.00	
27C801 Special While They Last	Gone	
Programmed eproms \$15 2/\$25 3/\$30 4/\$35 5/\$40 6/	\$45.00	
Specials On Common Programmed Proms/Eproms (None of these chips require board hacks.)		
Donkey Kong Prom 2E/2F/2N Set	\$21.00	
Donkey Kong Jr Prom 2E/2F/2N Set	\$21.00	
Star Wars Prom 7H/7J/7K/7L Set	\$30.00	
WMs Sound Rom choice 1-Def 2-Star 3-Rob 4-Jou 5-Bub	\$10.00	
Pac-Man Character Set 5E & 5F	\$20.00	
Ms Pac-Man Character Set 5E & 5F	\$20.00	
Pac/Ms Pac-Man 6F Original Speed	\$10.00	
Pac/Ms Pac-Man 6F Speed-up	\$10.00	
Pac/Ms Pac-Man Alternate Chips-Each	\$10.00	
Bootleg Ms Pac Speed-up	\$10.00	
Jr Pac Speed-up	\$10.00	
Altered Beast snd rom w Z80B	\$15.00	
Shinobi snd rom w Z80B	\$15.00	
WMs Decoder Prom Set 1 & 3 Upright Defender	\$20.00	

WMs Decoder Prom Set 2 & 3 Cocktail Table Defender	\$20.00	Sold Out
WMs Decoder Prom Set 4 & 6	\$20.00	Sold Out
WMs Sinistar Rom Set	\$55.00	
Atari A/R or A/R II-01 Repair Kit (Caps+Q2/3+R29)	\$12.50	
Atari A/R II-02 to -06 Repair Kit (Caps+Q2/3/8/9+R30)	\$17.00	
Atari A/R III Repair Kit (Caps + Q3/4/7/8)	\$23.00	
Atari A/R II-01 PCB connector kit 4/6/9 pos solder in	\$7.00	
Atari A/R II-02 PCB connector kit 4/6/6/9/12 pos solder in	\$12.50	
Atari A/R II-02 Harness connector kit 4/6/6/9/12	\$10.00	
Atari A/R II-02 PCB & Harness connector kit	\$15.00	
Atari AC Power Supply Repair Kit	\$25.00	
Atari AC Power Supply Repair Kit + 8' Line Cord	\$30.00	
Atari AC Power Supply Repair Kit + 10' Line Cord	\$32.00	
Atari 8' AC Line cord	\$6.00	
Atari 10' AC Line cord	\$8.00	
Atari Replacement Interconnect Cable - 24 Pos ILs .156 x 6"	\$18.00	
Atari Replacement Interconnect Cable - 24 Pos ILs .156 x 12"	\$20.00	
Atari 5 Position Fuse Holder	\$5.00	
Atari Fuse Kit - 8 Common SB Fuses 3A To 25A	\$7.00	
Fuse Extraction Tool	\$3.00	
Atari 35A bridge rectifier KBPC 3502	\$3.00	
Atari "Big Blue" Capacitor - (Transformer assembly)	\$12.50	
Atari 50 Ohm Volume Pot	\$32.00	
Knob #1 For Above Atari Pot	\$4.00	
Knob #2 For Above Atari Pot	\$2.00	
Knob #3 For Above Atari Pot	\$3.00	
Knob #4 w Allen Wrench For Above Atari Pot	\$4.00	
10k Sealed Pot	\$5.00	
Atari Crystals 10.000 MHZ	\$2.50	
Atari Crystals 12.096 MHZ	\$2.50	
<div>Atari/Happ Trackball Parts</div> <div>Which size do you have???</div> <div>Mini-Trak™ = 2¼" = 2½" OC Bolt Pattern</div> <div>Midi-Trak™ = 3" = 3 1/8" OC Bolt Pattern</div> <div>Maxi-Trak™ = 4" = 5"x4.5" OC Bolt Pattern</div> <div>4" Atari vs Capcom Roller</div>		
Atari trackball SS roller set 2¼" Centipede UR/Mini/CT CockTail only Missile Command & some of the other CT & Mini units (2 long shafts & 1 idler shaft)	\$10.00	
Atari trackball SS roller set 3" Crystal Castles UR/CT		

Marble Madness & Millipede UpRight/CT & other Midi units (2 long shafts & 1 idler shaft) Golf, Bowlers & etc with TB units of this kind only!!	\$12.00	
Atari trackball roller set 4" Football, Missile Command UR & other Maxi units (2 long shafts)	\$18.00	Sold Out
Atari TB bearing set (6) [Fits Mini or Midi]	\$15.00	
Atari TB bearing set (5) [Fits Maxi] Football & MC UR	\$15.00	
Atari TB kit (SS rollers & bearings) [2 1/4"]	\$25.00	
Atari TB kit (SS rollers & bearings) [3"]	\$27.00	
Atari TB kit (rollers & bearings) [4"]	\$30.00	Sold Out
13oz Can Spray Lubricant For Bearings	\$12.50	
Atari TB plastic housing mini or midi	\$15.00	
Atari/Happ TB plastic housing Shim	\$2.00	
Atari set of 6 OEM screws for above case	\$1.00	
Atari TB optic board A052-1010/1	\$15.00	
Atari TB encoder wheels (2) with screws	\$6.00	
Atari OEM Metal TB Encoder Wheel	\$4.00	
Atari TB wedge lamp sockets (2) with screws	\$3.00	
Atari/Happ TB replacement harness	\$8.00	
Atari TB black 3" mounting bolts (10) w nuts	\$5.00	
Atari TB 2 1/4" mounting plate	\$10.00	
Atari TB 3" mounting plate Use Happ NBS 3" TB Mounting Plate Below	\$00.00	Sold Out
Atari TB 2 1/4" ball off-wht only *** 6 Left colors	\$8.00	
Atari TB 2 1/4" ball snow white	\$16.00	Sold Out
Atari TB 2 1/4" ball black *** 6 Left	\$16.00	
Atari TB 2 1/4" ball red *** 4 Left	\$16.00	
Atari TB 2 1/4" ball blue *** 5 Left	\$16.00	
Atari TB 2 1/4" ball green	\$16.00	Sold Out
Atari TB 2 1/4" ball translucent red colors	\$17.00	Sold Out
Atari TB 2 1/4" ball translucent blue colors	\$17.00	Sold Out
Atari TB 3" ball white *** 16 Left	\$24.00	
Atari TB 3" ball black *** 12 Left	\$24.00	
Atari TB 3" ball blue	Sold Out	
Atari TB 3" ball red *** 9 Left	\$24.00	
Atari TB 3" ball yellow *** 1 Left	\$24.00	
Atari TB 3" ball green *** 3 Left	\$24.00	

Atari TB 3" ball red translucent	Sold Out	
Atari TB 3" ball blue translucent *** 2 Left	\$32.00	
Atari TB 3" Clear Translucent Ball *** 1 Left	\$50.00	
Atari Replacement TB Units Mini 2¼" complete w *Y* harness by Happ....will work with any TB game. Mini for a smoother "Reactor" with parts available. Off-Wht Ball	\$55.00	
Atari Replacement TB Units Midi 3" complete w *Y* harness by Happ....will work with any TB game. Parts have always been available. White ball	\$75.00	
Replacement 3" High-Ball TB Unit	\$95.00	
USB-PS/2 Trackball Interface Kit	\$40.00	
60-IN-1 Trackball Interface Harness	\$12.00	
TB Illumination Kit	\$6.00	
Capcom 4" Roller & Bearing Set - Compare Rollers	\$30.00	
Imperial & Wico 2 1/4" TB roller set Back in stock 2014	\$10.00	
Imperial & Wico 2 1/4" TB Bearing set (5)	\$15.00	
Imperial & Wico 3" TB stainless steel roller set	\$12.00	Sold Out
Imperial & Wico 3" TB Bearing set (6)	\$15.00	
Imperial & Wico 2 1/4" TB roller & bearing set Back in stock 2014	\$25.00	
Imperial & Wico 3" TB SS roller & bearing set	\$27.00	Sold Out
Imperial & Wico TB encoder wheels (2) with screws	\$4.00	
Imperial & Wico TB optic pcb	\$11.00	
Imperial & Wico TB replacement harness	\$9.00	
Atari 4" TB mating connector w socs	\$3.00	
Atari Tempest PCB Replacement Pot Kit (8)	\$12.00	
Replacement Spinner Knob	\$5.00	Sold Out
Happ NBS 3" TB Mounting Plate	\$13.50	
60-IN-1 Trackball Interface Harness	\$12.00	
Ms Pac-Man Ribbon Cable	\$10.00	
PCB Edge Repair Kit 22/44	\$8.00	
V-Ram Addresser (284) Pac Series	\$15.00	Sold Out
Z80 Sync Buss Controller (285) Pac Series	\$15.00	Sold Out
Buy Both V-Ram & Z80 Sync Buss As A Set	\$25.00	Sold Out
Ms Pac & others 8' AC line cord	\$6.00	
Ms Pac & others 10' AC line cord	\$8.00	
Midway Type 2 8' AC line cord	\$6.00	

Midway Type 2 10' AC line cord	\$8.00
Pac & others CT start & svc button	\$4.00
Pac harness for use with a switcher	\$45.00
Deluxe Pac Harness Kit	\$60.00
Ms Pac bootleg replacement harness	\$35.00
DC Pac Harness to JAMMA Tester Adaptor Kit	\$8.50
DC Pac Harness to JAMMA Deluxe Adaptor Kit	\$17.00
Galaga harness for use with a switcher	\$45.00
Deluxe Galaga Harness Kit	\$60.00
Bootleg Galaga harness for use with a switcher	\$40.00
Ms Pac/Galaga/others CP & Coin Connector Set	\$7.50
Midway Deluxe Harness Accessories Kit	\$15.00
Pac/Ms Pac Control Panel Harness	\$35.00
Pacpower Adaptor Kit	\$20.00
Deluxe Pacpower Adaptor Kit w 15A Switcher	\$40.00
Pac-Man 6-pack programmed eproms + speed-up	\$45.00
Ms Pac-Man 6-pack programmed eproms + speed-up	\$45.00
Other programmed eprom sets also available	
Pac series alternate 5E & 5F sets (Wiz)	\$25.00
Pac series programmed prom 1M - 3M - 4A - 7F each->	\$7.50
Pac series to Jamma adaptor connector kit (w scrap wire)	\$8.50
Pac series to Jamma Adaptor assembled	\$50.00
Pacland to Jamma Adaptor assembled	\$40.00
Pac series Z-80 Sync Buss Repair Kit (ICs + sockets) You plugged it in wrong..no problem..shotgun!	\$8.00
Pac series V-Ram Repair Kit (ICs + sockets) You plugged it in wrong..no problem..shotgun!	\$8.00
Pac IC Heat Sinks 4/	\$3.00
Ms Pac Sat Bds Cable Ties 10/	\$1.00
Pac PCB Touch-up Kit	\$5.00
Pac/Ms Pac PCB axial cap kit	\$7.50
Ms/Pac-Man crystals	\$2.50
Ms Pac-Man Lit Button Kit - No Trans Red Includes Trans Blue	\$20.00
Pac Fuse Kit 7 fuses to cover UR/MINI/CT	\$5.00
Galaga Fuse Kit	\$6.00
Fuse Extraction Tool	\$3.00
Pac-Man series 4 position fuse block	\$5.00
Pac-Man series set 4 pos & 2 pos fuse blocks	\$7.50
Pac-Man series set 4 pos & 3 pos fuse blocks	\$10.00
Fuse block with 22/44 Molex connector with split pins	\$19.00
Ms Pac-Man Manuals	\$20.00

Bally Squawk & Talk Cap Kit	\$15.00
Bally 2518-32 Sound Board Cap Kit	\$4.00
Pac-Man/Space Inv/SID coin boxes (NEW)	\$6.00
Galaga to Jamma adaptor connector kit (no wire)	\$10.00
Galaga to Jamma Adaptor assembled	\$40.00
Galaga/Super Pac/Other 2 bd sets Interconnect Ribbon	\$4.00
Midway OEM PS (90400) Cap Kit	\$15.00
Gorf & others OEM PS (90411) Repair Parts Kit	\$21.00
Midway OEM 90420 Parts Only Repair Kit	\$19.00
Space Invader PS 24 Pos Harness Connector w Socs	\$10.00
Super Pac-Man > Jamma adaptor connector kit	\$9.00
Super Pac-Man to Jamma Adaptor assembled	\$40.00
Super Pac-Man & others OEM PS (90421) Repair Kit	\$20.00
Stern PS-1200 Power Supply Parts Kit	\$22.00
Tron/MCR PS 90412 Harness Connector Set	\$9.00
Tron OEM PS connector repair kit	\$15.00
Tron & others OEM PS (90412) Repair Kit	\$25.00
3.6V Ni-Cad Battery	\$2.00
Midway (MCR) Capacitor 55,000uf 25v	\$15.00
Midway (MCR) Capacitor 100,000uf 16v	\$20.00
QD Kit For Above CG Caps (Kickman & Others)	\$2.00
Tron/MCR Replacement Video Cable	\$10.00
Tron Lithium Battery Conversion Kit	\$4.00
Tron, et al MCR 4" SCSI cables - 5 dual row(25/50)	\$20.00
Wms Battery Conversion Kit (All triple AAs to Lithium)	\$4.00
Wms Service Switch Assembly Replacement Switch Set(3)	\$6.00
Wms Replacement Cap red or blk for above	\$1.00
Wms Ribbon Cable Main PCB to Rom PCB	\$10.00
Wms Ribbon Cable Main PCB to Interface PCB	\$9.00
Wms Ribbon Cable Main PCB to Speech PCB	\$10.00
Wms PCB Mounting Bolts (25)	\$2.50
Wms 4116 to 4164 Ram Power Adaptor	\$12.00
Wms 4116 to 4164 Ram Power Adaptor + 24/4164	\$35.00
Wms Defender PS Connector Kit	\$3.50
Wms Stargate & Up PS Connector Kit	\$4.50
Wms Def/Star/Bub/Rob/Jou OEM PS REPAIR Kit	\$12.50
Wms OEM PS Connector & Repair Kit (Caps/ICs) Kit 1 Defender only	\$15.00
Wms OEM PS Connector & Repair Kit (Caps/ICs) Kit 2 Stargate & later games	\$16.00
Wms OEM PS Deluxe Repair Kit	\$37.50

Single Digit Display (WMs)	\$1.00	
Wms Decoder Replacement Eprom Set		
WMs Decoder Prom Set 1 & 3 Upright Defender	\$20.00	Sold Out
WMs Decoder Prom Set 2 & 3 Cocktail Table Defender	\$20.00	Sold Out
WMs Decoder Prom Set 4 & 6	\$20.00	Sold Out
Wms Sound Board Cap Kit	\$7.00	
Wms Sound Board Crystals (new)	\$4.00	
Wms Fuse Kit	\$5.00	
Fuse Extraction Tool	\$3.00	
Wms Sound Board Replacement Volume Control Defender/Stargate/Bubbles/Robotron/Joust/others	\$10.00	
Wms wiring harness Molex IL connectors' kit Revamped-exact sizes-no cutting necessary	\$15.00	
Sinistar wiring harness Molex IL connectors' kit	\$18.00	
Wms To JAMMA Connector Kit	\$29.00	
NBA Jam Power & Speaker Cable	\$10.00	
NBA Jam Volume Control/Cable	\$12.00	
NBA Jam Ribbon Cable	\$8.00	
MK Power & Speaker Cable	\$10.00	
MK Volume Control/Cable	\$12.00	
MK Ribbon Cable	\$8.00	
MK II Power & Speaker Cable	\$10.00	
MK II Ribbon Cable	\$8.00	
Smash TV Power & Speaker Cable	\$10.00	
Smash TV Ribbon Cable	\$8.00	
Total Carnage Power & Speaker Cable	\$10.00	
Total Carnage Ribbon Cable	\$8.00	
New & Slightly Used Manuals For Many Midway Games <ul style="list-style-type: none">• Killer Instinct 2• Killer Instinct 2 Rom Kit• Mortal Kombat• Mortal Kombat Kit• Mortal Kombat II• Mortal Kombat II Kit• Mortal Kombat II T-Unit Kit• Mortal Kombat 3• NBA Jam• NBA Jam Kit• NBA Jam Hangtime Kit• Smash TV	\$12.50	

Amplifone flyback (A201005-01)	\$30.00
Electrohome GO7 flyback (A29951B)	\$25.00
G07 Flyback & Cap Kit	\$30.00
GO7 Flyback Repair Kit	\$33.00
G07 Super Repair Kit	\$42.00
G07 Deluxe Repair Kit	\$45.00
Hantarex flyback MTC 9000 10" Color 28025490	\$40.00
Hantarex flyback MTC 9000 14"-25" 28026031	\$25.00
Hantarex MTC9000 Flyback & Cap Kit	\$30.00
Hantarex MTC9000 Flyback + Cap Kit + HOT	\$33.00
Hantarex flyback MTC 9000/B Polo 28028800	\$25.00
Hantarex Polo Flyback & Cap Kit	\$30.00
HR 7185 Flyback	\$40.00
D9200 flyback replacement	\$25.00
K6100 flyback (053X0487-1)	\$32.00
K6100 flyback (053X0487-1) + K6100 Deuxe Cap Kit	\$75.00
K7000 flyback replacement (053X0528-001)	\$25.00
K7000 Flyback & Cap Kit	\$30.00
K7000 Flyback Repair Kit	\$33.00
13K7201 or 19K7201 flyback replacement (053X0641-001)	\$25.00
K7400 or K7500 flyback replacement (053X0671-001)	\$28.00
K74/7500 Flyback & Cap Kit	\$40.00
Sharp Image SI-727R DS flyback replacement	\$30.00
Sharp Image SI-727R DS flyback replacement + Cap kit	\$40.00
Sharp Image SI-727R DS flyback + Cap kit + Hot + B+ Filter	\$47.00
U2000 flyback replacement 25/27"(053X0632-001)	\$28.00
U3000 flyback replacement (053X0639-001)	\$28.00
U5000 flyback replacement (053X0624-001)	\$28.00
U5000 Flyback & Cap Kit	\$40.00
KFS-60717	\$25.00
KFS-61088A	\$28.00
Kortek flyback KFS-60737	\$25.00
Sanyo 20EZ Flyback	\$25.00
Sanyo 20EZ Flyback & Deluxe Cap Kit	\$37.00
Kortek flyback	\$35.00
Matsushita TM201/2G flyback TLF-6041F	\$25.00
Neotec flyback MRCFT-216	\$30.00
Neotec flyback MRCFT-249 Med Res	\$30.00
Neotec flyback MRCFT-252	\$30.00
Neotec flyback MRCFT-455	\$30.00

Neotec flyback MRCFT-923A	\$30.00	
T-5002B Flyback	\$25.00	
Wells-Gardner Width Coil 9A2838-005	\$15.00	
Hot Box Kit	\$25.00	
Cap Kit Monitor ID Page		
Cap Kit Price List		
Zener diode 150 volt	\$2.50	
Nintendo Audio Board Repair Kit	\$5.00	
10' RGB monitor extension cable	\$20.00	
10' Isolation AC monitor extension cable	\$10.00	
V2000 Monitor To G05-801 Wired Cabinet Adaptor	\$20.00	
G05-801 Monitor To V2000 Wired Cabinet Adaptor	\$20.00	
XY Output Harness Short	\$12.50	
XY Output Harness Long	\$12.50	
Power Supply Tester Harness	\$20.00	
Atari A/R Adaptor To Basic PS Test Harness	\$7.50	
Galaga Adaptor To Basic PS Test Harness	\$7.50	
Std Switcher Adaptor To Basic PS Test Harness	\$7.50	
Williams Adaptor To Basic PS Test Harness	\$7.50	
Each Adaptor When Purchased With PS Test Harness	\$5.00	
Test Switch For PS Test Harness	\$2.50	
Frogger Replacement Volume Control & Cable	\$10.00	
Building a game from scratch? Start here!		
Cab AC Wiring Starter Kit	\$50.00	
Cab DC Wiring Starter Kit	\$95.00	
Drop-in AC Power Center	\$120.00	
Isolation Xformer 1:1 Happ has the last off the line at \$22.92... Part # 80-2000-00	NLA	
Isolation Xformer 1:1 Shielded	NLA	Sold Out
Isolation Xformer Harness	\$10.00	
14VAC Xformer with 24VCT winding	\$10.00	
15 Amp Standard Switching Power Supply	\$25.00	
Adaptor From Std 15A PS To PC Type Cab Harness	\$7.50	
20 Amp Switching Power Supply	\$30.00	
Mating Connector Kit To The 20 Amp PS Above	\$5.00	
Switching Power Supply - w 12V4A & -5V1A	\$30.00	Sold Out
Switching Power Supply - w 12V4A & -12V1A	\$30.00	
AC Line Cord 8' 3 conductor black 18ga	\$5.00	
AC Line Cord 10' 3 conductor black 18ga	\$7.00	

AC Line Cord 12' 3 conductor black 16ga Right Angle Plug	\$9.00	
AC Line Cord 11 ½' Flat 3 Conductor Black w Filter	\$16.00	
AC Line Cord 11 ½' Flat 3 Conductor Black NO Filter	\$8.00	
AC Line Cord 6' Plug-n-Play to PC Type Power Supply (gry)	\$2.50	
AC Line Cord 6' Plug-n-Play to PC Type Power Supply (Blk)	\$4.50	
AC Line Cord 8' Plug-n-Play to PC Type Power Supply	\$5.00	
AC Line Cord 10' Plug-n-Play to PC Type Power Supply	\$7.00	
AC Line Interference Suppressor Kit	\$1.00	
AC Line Cord 1' Extension Cord	\$2.00	
AC Power On/Off Switch	\$2.00	
AC Power On/Off Switch DPST .25 tabs	\$3.50	
AC Power On/Off Switch DPDT .25 tabs	\$4.50	
Safety sw & mounting bracket	\$4.00	
AC On/Off sw mounting plate factory stamped	\$5.00	
AC On/Off Switch & Mounting Plate Pre-assembled	\$8.50	
Degausser Switch - Other Rocker Sw Uses	\$2.50	
On/Off DPST Switch	\$2.50	Sold Out
20mm PC Type A Fuse Clips 2/	\$1.00	
20mm PC Type B Fuse Clips 2/	\$1.00	
1.25" Standard Fuse Clips 2/	\$1.00	
Fuse Extraction Tool	\$3.00	
AC line fuse block/holder (¼" fuses)	\$1.00	
AC line fuse block/holder (¼" fuses) double	\$2.00	
AC line fuse block/holder (¼" fuses) quad	\$5.00	
AC line fuse block/holder (¼" fuses) Atari 5	\$5.00	
AC line breakaway fuse block (¼" fuses) 10 position	\$10.00	
AC 3A fuse & holder	\$2.00	
AC Panel Mount Fuse Holder	\$2.00	
AC line filter .25 tabs	\$10.00	
AC power 2 quad distribution block .187 tabs	\$4.00	
AC power 4 quad distribution block .187 tabs	\$5.00	
AC power 8 quad distribution block .187 tabs	\$6.00	
AC Distribution Block Tabs From	\$0.15	
AC Interlock switch (F-79) & Holder	\$8.00	
AC Interlock switch on-off-mom .187 tabs (F-79)	\$6.00	
AC Interlock switch mounting bracket for F-79	\$3.00	
AC Interlock switch mnting bracket/enclosed plastic for F-79	\$3.00	
AC Interlock switch (E-69)	\$4.00	
AC Interlock switch mounting bracket for E-69	\$3.00	
AC Line Tap Harness w Molex connector	\$7.50	

AC Isolation Xformer Harness	\$10.00	
AC Line Extension with .25 QDs	\$3.50	
Cable Clamps & Cable Ties		
Spiral Wrap - Coin Door Harness Protection \$1/ft or 5'	\$3.00	
Coin Switch T2 with trip wire you form	\$4.00	Sold Out
Coin Switch T3 with pre-formed trip wire	\$5.00	Sold Out
"L" Coin Sw Trip Wire/Retainer	\$1.25	
Straight Coin Sw Trip Wire/Retainer	\$1.25	
Coin Controls Coin Door Trim Set	\$20.00	
Coin Door Mounting Bolts (10)	\$2.00	
Coin mechs Happ 25¢ Mech NEW	\$12.00	Sold Out
Coin mechs Imonex 25¢ Mech	\$25.00	Sold Out
5 Volt Coin Counter NEW	\$5.00	
Pack of 4 New Coin Mech Mounting Studs	\$2.00	
Coin Rejector Return Spring	\$1.50	
Coin Controls Coin Insert	\$1.00	
Happ Coin Inserts 2 for	\$1.00	
Generic peel & stick coin inserts - sheet of 25	\$6.00	
Over/under Jamma coin boxes	\$6.00	
Pinball style coin box	\$8.50	Sold Out
Cover for above coin box	\$17.50	
Dip Switch 4 pos	\$1.00	
Dip Switch 8 pos	\$2.00	
Dip Switch 10 pos	\$2.00	
Test Switch	\$2.50	
Test Switch	\$1.00	
Small Dual Test Switch/Bracket/Screws	\$5.00	
Dual Test Switch/Bracket/Screws	\$6.00	
Small Dual Test On/Off Switch/Bracket/Screws	\$7.00	
HD Dual Test Switch/Bracket/Screws	\$7.50	
BR2325 Battery & Holder	\$3.00	
Super Shielded Multi-Conductor Cable Per/Ft	\$1.00	
20 gauge wire pack--10 colors 10'each--100' total wire	\$12.00	
18 gauge wire pack--6 colors 10'each--60' total wire	\$12.00	
PCB Interconnect Cables	\$4.00	
Nintendo Rainbow PCB Interconnect Cables	\$10.00	

15 Amp Standard Switching Power Supply	\$25.00	
3" 12VDC Cooling fan	\$3.50	
3" Metal Guard for Cooling Fan	\$2.00	
4.69" sq 12VDC Cooling fan	\$6.00	
4.69" sq 110VAC Cooling Fan	\$10.00	Sold Out
4.69" Metal Guard for Cooling Fan	\$2.00	
8 ohm 5 watt 4X4 speaker	\$2.50	Sold Out
8 ohm 15 watt 4X4 speaker	\$4.00	
8 ohm 50 watt 4" Speaker & Grille	\$7.00	Sold Out
8 ohm 12 watt shielded 4X4 speaker NEW	\$10.00	
8 ohm 8 watt 5" round speaker NEW	\$8.00	Sold Out
8 ohm 12 watt shielded 5" round speaker NEW	\$8.00	Sold Out
4 Ohm 20 Watt Shielded 5¼" Round Speaker NEW	\$8.00	
4 ohm 15 watt 6X9 Speaker NEW	\$12.00	Sold Out
8 ohm 15 watt shielded 6X9 speaker NEW	\$12.00	
Round Speaker Grilles W Mounting Hardware	\$2.50	
JAMMA Harness Info		
Economy JAMMA Harness Pinout	\$32.00	
Fully Loaded JAMMA Harness Pinout	\$36.00	
Neo Geo/JAMMA Harness Pinout	\$36.00	
Super-Super Jamma Harness Kit	\$45.00	
Old ABC KO Jamma harness color code		
Custom Starter Harnesses Non-JAMMA Starting At	\$40.00	
3' Jamma Extension harness	\$45.00	
Spare 5' 20ga wires w split pin already attached 6 for	\$4.00	
Spare 5' 20ga striped wires w split pin already attached 6 for	\$5.50	
Spare 5' 18ga wires w split pin already attached 6 for	\$6.00	
Jamma Polarizing Key	\$2.00	
Jamma *Plus** Kicks **Extra* harness complete	\$20.00	
CP side only with ground loop and QDs for above	\$16.00	
PCB side only...SF/SFII/MK/MKII/MKIII/SSF/Etc	\$10.00	
Konami 3 & 4 Player Harness	\$35.00	
MVS -5 volt Add-on Cable	\$2.00	
Video/Sync Standard Output to Nintendo Input Adaptor	\$6.00	
Replacement Video/Sync Harness	\$6.00	
Replacement Video/Sync Harness w Jamma Pins	\$7.00	

Replacement Video/Sync Harness w Galaga Termination	\$8.50	
Replacement Video/Sync Harness For Bootleg Galaga	\$7.00	
Replacement Video/Sync Harness w Super Pac Termination	\$8.50	
Replacement Video/Sync Harness w Tron Termination	\$10.00	
Replacement Video/Sync Harness w MCR Long (5')	\$10.00	
Replacement Video/Sync Harness w WMs Termination	\$7.00	
Replacement Taito "H" Power Cable	\$12.50	
Custom Assembled Adaptors Starting At	\$30.00	
Assembled Capcom To JAMMA Adaptor	\$40.00	
Assembled Ikari Warriors To JAMMA Adaptor	\$35.00	
Assembled Konami To JAMMA Adaptor	\$35.00	
Assembled Phoenix To JAMMA Adaptor	\$35.00	
Assembled Sega 16 To JAMMA Adaptor	\$40.00	
Assembled Track n Field To JAMMA Adaptor	\$35.00	
Joysticks		
Ultimate 4-way Joystick w Heavy Spring Blu/Yel/Grn	\$11.00	
Ultimate 8-way Joystick w Heavy Spring Blu/Yel/Red/Blk/Grn	\$11.00	Sold Out
Ultimate 4-way Joystick Blue/Yellow/Green	\$9.00	
Happ Ultimate Joys 8-way Blue/Yellow/Red /Black/Green	\$9.00	Sold Out
Happ Ms Pac-Man/Galaga Replacement Joysticks 4-way	\$18.00	
Ms Pac-Man/Galaga/Space Invaders Tall Joystick 4-way	\$20.00	
Ms Pac joystick with adaptor plate & hardware	\$25.00	Sold Out
Mounting plate to Ms Pac-Man for most std joysticks	\$12.00	Sold Out
Ms Pac-Man Joystick Adaptor Plate Without Hardware		Sold Out
Joystick mounting plate/hardware for wood CP	\$10.00	
Midway Joystick Centering Grommet For Use With OEM Pac Series/BurgerTime/Bosconian/Rally-X/Other Sticks	\$14.00	\$11.00
Happ Joystick Heavy Spring	\$2.00	
Grip Asemblies R or L w/o thumb sw	\$10.00	
Grip Asemblies R or L w thumb sw	\$17.00	
Button Hole Plug For 1 1/8" Holes	\$1.25	
Button Hole Plug For 7/8" Holes	\$1.25	
Happ Microswitch Pushbutton Complete BLACK		\$1.25
Happ Microswitch Pushbutton Complete RED		Sold Out
Happ Microswitch Pushbutton Complete ORANGE		\$1.25
Happ Microswitch Pushbutton Complete YELLOW		\$1.25

Happ Microswitch Pushbutton Complete GREEN		\$1.25
Happ Microswitch Pushbutton Complete BLUE		Sold Out
Happ Microswitch Pushbutton Complete VIOLET		\$1.25
Happ Microswitch Pushbutton Complete WHITE		Sold Out
Many have been asking me to reinstate the buttons only for replacing cigarette burned buttons using your old switches & nuts, so... they're back!		
Happ Pushbutton Only R/G/Y/P/O/BLK No sw/nut	\$1.15	Sold Out
Pack of 4 Happ Pushbutton nuts	\$1.00	
White player 1 pushbutton	\$2.00	
White player 1 & 2 pushbutton set	\$3.50	
White player 3 & 4 pushbutton set	\$3.50	
Happ Lit Microswitch Button Set	\$12.50	
Happ Competition Microswitch Pushbuttons (Convex)	\$1.50	Sale \$1.00
The term "cherryswitch" over the years has become synonymous with microswitch & the many places, including our site, that refer to micro-switches as cherry switches are actually microswitches & not the brand name Cherry switches. Following the majority of the industry we sell E-switch brand microswitches that most of you have requested.		
Replacement Microswitches .187 tabs 10 for	\$9.00	
Replacement Microswitches .187 tabs 10 for	\$10.00	
Replacement " " .187 tabs w/actuators 10 for	\$12.50	
Button Wrench	\$2.50	
Replacement Leaf Switch For Joystick Import	\$1.25	Sold Out
Set Of 4 Leaf Switches For Joystick Import	\$4.00	Sold Out
Joystick Fiber Leaf Switch	\$4.50	
Replacement Fiber Leaf Switch	\$3.00	Sold Out
Leaf Button Fiber Leaf Switch	\$4.00	
Leaf Switch Parts - Blades-Separators-Fish Paper		
Used WMs Leaf Button Switch	\$4.00	Sold Out
New WMs Leaf Button Switch Screws (25)	\$2.00	
Leaf Switch Button Assembly		
Leaf Button Colors AND 2006 Pricing		
Short Button Colors Available		
Two Tone Short Snap Buttons	\$2.50	
Leaf button only short		

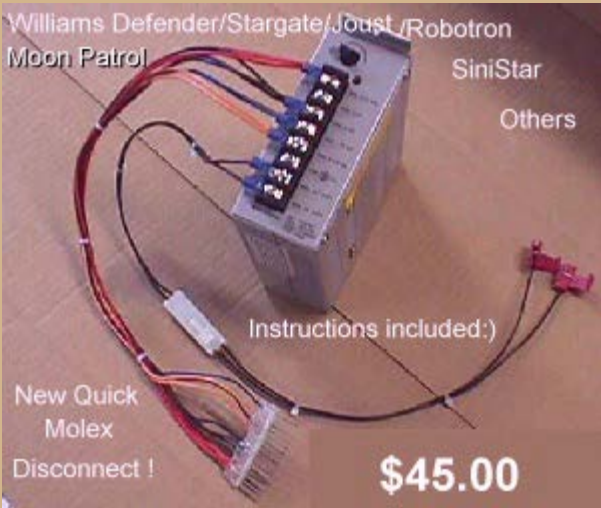
Color Choice Red/Lt Blu/Blu/Blk/Lav/Trans Grn/Trans Orn, Orn/Grn/Yel/ Galaga Gold	\$1.00	
Long Button Colors Available		
Leaf button only long Color Choice Grn/Orn/Lav/Gry/Blk/Red/Yel/Lt Blue/Blu Trans Grn/Trans Orn	\$1.00	
Leaf sw button long Wht	\$2.00	
Leaf sw button Short Snow Wht	\$2.00	
Leaf sw button Short Blue Translucent	\$2.00	
Leaf sw button Short Green Apple NEW	\$1.00	
Leaf sw button Short Candy Apple Red NEW	\$1.00	
Leaf sw button Short Pure White NEW	\$1.00	Sold Out
Leaf sw button Short Midnight Black NEW	\$1.00	Sold Out
Leaf sw button Short Midas Gold NEW	\$1.00	
Leaf sw & holder only for wood CPs Gold Flashed Contacts	\$4.00	
Leaf sw & holder only for wood CPs w fiber switch	\$4.50	
Leaf button assembly complete long with button	\$5.00	
Leaf sw & holder w spacer for metal CPs Gold Contacts	\$5.00	
Leaf sw & holder only for metal CPs w spacer & fiber switch	\$5.50	
Leaf button assembly complete short with button	\$6.00	
Leaf sw pal nuts (Needed for above holders!) 5 for	\$1.00	
Leaf Button Spacer	\$1.00	
Replacement Leaf Switch - Nylon -	\$3.50	Sold Out
Replacement Leaf Switch	\$3.00	
Replacement Leaf Switch - Fiber -	\$4.00	
When buying button sets be sure to check your CP to get the correct length. There are many conversions in existence and the number keeps growing every day. Wood CP or wood backed metal = Long! Metal CP=Short! Not set in stone, so take one out & measure it in comparison to this . If a set below is only listed in short just edit to "long" or vice versa.		
Atari APB Short Button Set	\$4.00	
Atari Asteroids Short Button Set	\$10.00	
Konami Track & Field Short Button Set	\$14.00	
Midway Galaga Short Button Set	\$3.00	
WMs Defender Short Button Set	\$11.00	
WMs Stargate Short Button Set	\$12.00	
TOOLS		

Flashlight-Tool Kit	\$10.00	
SafeBack Discharger Kit	\$10.00	
SafeBack Discharger Assembled	\$12.00	
Security Torx Bits/Handle	\$7.00	
100 Piece Security Bit Set	\$10.00	Sold Out
Pocket Bit & Socket Ratchet	\$2.00	
Pocket Ratchet w Bits & Sockets	\$5.00	Sold Out
Screwdriver Kit	\$10.00	
Pocket Screwdriver Set	\$3.00	Sold Out
Screwdriver w Four Bits	\$2.50	Sold Out
Set Of 6 Security Hex Bits	\$5.00	Sold Out
Set Of 7 Torx Bits	\$5.00	Sold Out
Cable Tie Tool	\$10.00	
Cable Tie Gun	\$8.00	
Utility Knife	\$1.00	
Reaming tool Finally! Back in stock after 6 months BO... with 7 distributors! Partial received, so get one while you can.	\$9.00	
Helping Hands w Magnifier Okay! You Win! Restocked These Due To Your Many Requests	\$5.00	
Fuse Extraction Tool	\$3.00	
IC pin straightener	\$10.00	
IC Test Clip 14 Pin DIP	NLA	
IC Test Clip 16 Pin DIP	NLA	
IC Test Clip 20 Pin DIP	NLA	
IC Test Clip 28 Pin DIP	\$10.00	
IC Test Clip 40 Pin DIP	\$12.00	
IC Extractor 92-0022	\$2.00	
.156 pin extractor	\$10.00	
.062 pin/soc extractor	\$20.00	
.093 pin/soc extractor	\$20.00	
Amp Manual.084 pin/soc extractor	\$20.00	
Amp pin/soc extractor	\$50.00	
Adaptor Aid	\$10.00	
Joystick template	\$2.00	
Hook Tool	\$2.50	
Hook & Scribe Tool	\$5.00	

Hook & Scribe Set	\$3.00	
HT-1921 Crimping Tool	\$16.00	
Standard Crimpers - Not For Pins & Socs	\$3.00	
Tool Grip	\$2.00	
Set of 6 Jeweler's Precision Screwdrivers	\$2.00	
Pocket Screwdriver	\$1.00	Sold Out
Philips Pocket Screwdriver	\$1.00	Sold Out
3pc Precision Screwdriver Set	\$2.00	
Long Screwdriver Flat Blade	\$4.00	
Long Screwdriver Phillips #2 Blade	\$4.00	
Screwdriver Set 3 Phillips & 3 Flat Blade	\$4.00	
Bob's Plastic Alignment Tool Set (horiz width coils)	\$4.00	
6 Piece Plastic Alignment Tool Set (horiz width coils)	\$7.00	
9 Piece Plastic Alignment Tool Set (horiz width coils)	\$8.00	
16" Non-conductive Adjustment Tool	NLA	
Degaussing Coil 13" Pro	\$50.00	
Pocket Multitester (Analog)	\$8.00	
Pocket Multitester (Digital)	\$8.00	
1 1/8" Step Drill (CP holes) New	\$50.00	
Flushcutters The Must have Tool For Electronics!		
PLATO Flushcutters You Asked For The Real Plato - Here They Are!!	\$8.00	
Xcelite Flushcutters	\$7.00	
JP10A Flushcutters	\$6.00	
Duratool Flushcutters	\$5.00	
Import Flushcutters	\$5.00	
Spring loaded solder sucker	\$5.00	
Soldering Iron Stand	\$5.00	
Soldering Iron 30W	\$5.00	
Soldering Starter Kit	\$12.50	
Packet Of 60/40 Solder	\$1.00	
Tube Of Solder	\$1.50	
Desoldering Braid	\$2.00	
1LB Roll Of Solder	\$12.50	Sold Out
Temperature Controlled Solder Station	\$18.00	Sold Out
Pack of 4 Tips For Above Solder Station	\$7.50	
10oz Can Freeze Spray	\$10.50	
Pushbutton Wrench	\$2.50	

Circuit Breaker Tester - Save Your Fuses	\$5.00	
Mirror Monitor Aid	\$0.50	
Magnifying Glass	\$1.50	Sold Out
Leaf Switch Blade Adjusting Tool	\$3.00	Sold Out
Set of 10 HD Jumper Leads with Alligator Clips Techs Call Them "Fuses On A Leash" :-)	\$4.00	
Prototype Board Small	\$1.00	
Prototype Board Medium	\$1.50	
Prototype Board Large	\$2.50	
Small Parts Boxes - Your Choice	\$3.00ea	
Parts Box Rounded Bottoms & Sealed Tops For Small Parts	\$4.00up	
The Carriage Bolts Below Come With Kep Nuts		
Carriage bolts 8-32 x 3/4" Nickel Plated w Nuts (Pac CP) 10 for	\$4.00	
Carriage bolts 8-32 x 1 1/8" yellow 4 for	\$2.00	
Carriage Bolts 8-32 x 1 1/2" Shiny 10 For	\$4.00	
Carriage Bolts 8-32 x 1 1/2" Black 10 For	\$5.00	
Carriage bolts 3/16" x 1 1/4" black 10 for	\$3.00	
Carriage bolts 3/16" x 1 1/4" stainless 10 for	\$3.50	
3/16" x 1 1/4" Black Carriage Bolts 10 For	\$4.00	
Carriage bolts 3/16" x 2" black 10 for	\$4.00	
Carriage bolts 3/16" x 3" black 10 for	\$5.00	
Carriage Bolt Assortment Kit	\$21.00	
Bag of 10 1.25" Shiny Carriage Bolts/K-Nuts (No Stamp)	\$3.00	
Bag of 10 2" Shiny Carriage Bolts/K-Nuts	\$3.50	
Bag of 10 3" Shiny Carriage Bolts/K-Nuts	\$4.00	
48-Pc Mounting Bolt Kit	\$5.00	
Miscellaneous Hardware Packs	\$1.00	
1 1/8" or 1 1/2" slotted 440 pan head mach screws (10)	\$2.00	
1 1/2" philips 440 pan head machine screws (10)	\$2.00	
1/2" 8-32 Phillips pan head mach screws/washers (25)	\$2.50	
2" 8-32 Phillips pan head mach screws/washers/nuts (4)	\$2.00	
#6 Truss head 1/4" philips screws (4)	\$1.00	
# 6 Pan head 1/2" philips screws (100) (T03)	\$2.75	
# 6 Pan head 3/4" philips screws (100)	\$3.00	
# 6 Rd head 1" philips screws (100) WMs Leaf Switches	\$5.00	
#8 washerhead 1/2" screws (50) Shiny	\$2.50	
#8 washerhead 1/2" screws (50) Black	\$2.50	
#8 washerhead 3/4" screws (50) Black	\$2.50	
#8 panhead 3/4" screws (50) Black Course Thread Wood or MDF	\$2.50	

#8 washerhead 1" screws (50) Black	\$2.50
#8 Phillips 1 1/2" screws (100) Black	\$2.50
#8 Phillips 2" screws (100) Black	\$3.00
Pack of 4 New Coin Mech Mounting Studs	\$2.00
Pack of 10 New Coin Door Mounting Bolts	\$2.00
Pack of 25 New WMs Leaf Switch Screws	\$2.00
Pack of 25 Washers - Your Choice	\$1.00
TO220 mounting hardware kit	\$1.00
T03 Mounting Kit	\$2.00
Pcb adjustable holder...easily change pcbs	\$7.00
Pcb mounting feet (4)	\$3.00
Pcb mounting feet for 2 bd set (4)	\$4.00
Pcb mounting feet to cab screws (12)	\$1.00
Pcb 3/4" Threaded Spacers	\$3.00
5/8" pcb standoffs (24)	\$3.50
Assortment of Spacers & Standoffs	\$3.50
Snap-in Wire Guide Standoffs	\$1.00
Pair of Midway Cabinet Handles	NLA
Control panel latches set (2)	NLA
CP latch & strike set	\$6.00
Video Game Leg Levelers (4)	\$4.00
Small Video Game Leg Leveler Mounting Plates	NLA
Video game leg leveler mounting plates	\$9.00
Bob's Leveling Kit	\$18.00
We Heard Ya Again... Even Louder & Brought Back The Two Items Above	
Set of 4 Black steel cabinet corner <u>protectors</u>	\$12.00
7/8" Cam locks keyed alike 641	\$5.00
1 1/8" Cam locks keyed alike 641	\$5.00
Lock set keyed alike 641 <u>(1)1 1/8" & (2) 7/8"</u>	\$13.00
Spare 641 Key	\$1.00
Various Cams Sold Out - All that are left are on the Dollar Store	\$1.00
Cam lock anchor plate	\$2.00
Nintendo K6510 Key	\$5.00
Key Hooks 2/	\$1.00
4 Mil 10x12" <u>Manual Zip Lock Bags</u> 20 for	\$5.00
Misc PCBs Forsale by Pic	
Pinball Parts Closeout	



Power Supply Conversions Pic'd Above	
Galaga/Rally-X complete with 15A PS	\$45.00
Galaga/Rally-X harness assembly only	\$30.00
Mappy/Super Pac-Man complete with 15A PS	\$55.00
Mappy/Super Pac-Man harness assembly only	\$40.00
Williams games as pic'd complete with 15A PS	\$45.00
Williams games harness assembly only	\$30.00

This is my way of hopefully contributing to the preservation of the declining numbers of *Classic* video arcade games. A labor of love for the classics, for sure, and an unintrusive way to incorporate new technology into these older games.



****Email Orders Only**** Snail mail orders without a prior email confirmation will be returned. Any changes to orders must be approved by email. No snail mail changes will be honored.

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Batteries

tr>

Batteries - Batteries - Batteries	
23A Power Cell 12 volt PIC	\$2.00
357 Button PIC	\$1.00
BR1220 Lithium	\$2.00
BR1225 Lithium PIC	\$2.00
BR2325 Lithium PIC	\$2.00
CR2032 Lithium PIC	\$2.00
CR2032 Lithium Vertical Mount PIC	\$2.00
L626 Button PIC	\$1.00
L736 Button PIC	\$1.00
L1131 Button PIC	\$1.00
LR44 Button PIC	\$1.00

Battery Equivalents					
23A (12V)	A23	E23A	GP23A	MN21	V23
357 (1.5V)	SR44W	AG13	228	D357	V357
BR1220 (3V)	CR1220				
BR1225 (3V)	CR1225				
BR2325 (3V)	CR2325				
CR2032 (3V)	BR2032	DL2032			
L626 (1.5V)	LR66	AG4	377	SG4	
L736 (1.5V)	LR41	AG3	192	SG3	
L1131 (1.5V)	LR1130	AG10	189	SG10	
L1154 (1.5V)	LR44	AG13	357	SG13	A76

Also In Stock [3.6VDC Ni-Cad Batteries](#) For \$2.00 Each

Used Books

Updated 3/25/16

Books That May Be Of Use To Someone	
Owners Pictorial Guide for the Care and Understanding of the Mills Bell Slot Machine	\$25.00
Owners Pictorial Guide for the Care and Understanding of the Watling Bell Slot Machine	\$25.00
Handbook of Wiring, Cabling and Interconnecting for Electronics © 1972	\$5.00
Printed Circuits Handbook © 1967	\$5.00
Exar Databook © 1992	\$1.00
CMOS Cookbook © 1988	\$12.00
TI Scientific TI-35 Plus Guidebook © 1986	\$1.00
1993 IC Masters Set - 1,2 & 3	\$12.00
Seeburg Slots - 5LW16/3MW-12/5MW-11/3LW-11 3LW-12/P-3LF-4R-2/5MF-11A/6LR-12	\$20.00

These books can be shipped at USPS media rate which is much less than parcel post & only takes a few days more.

Connector Page

Updated 6/19/2014

Smaller Amounts Of Pins & Sockets Can Be Found On the [Dollar Store](#).

[Also Available Pins & Sockets Kit For \\$13.](#)



10 Pieces Of Each - 100pc Kit

Molex in-line .100 center Bally / Midway brown small pin style.	
How To Determine .100 or .156 Header/Connector The Easy Way	
.100 Right Angle header 10 pos break-away Add or Subtract to meet your needs	\$1.00
.100 Right Angle header 40 pos break-away Add or Subtract to meet your needs	\$2.50
.100 Straight header 11 position	\$1.00
.100 Straight header 15 position	\$1.25
.100 Straight non-Molex header 36 position	\$1.50
.100 x 20 Straight Double Header 2/	\$1.00
.100 x 50 Straight Double Header	\$1.00
.100 Housings with pins 10 pos(Jamma plus/pinball)	\$1.50
.100 Housings with pins 12 pos(Jamma plus/pinball)	\$2.00
.100 Housings with pins 15 pos(Jamma plus/pinball)	\$2.50
.100 Housings with pins 16 pos(Jamma plus/pinball)	\$2.75
.100 Housings with pins 24 pos(Jamma plus/pinball/Tron)	\$3.25
.100 Housings with pins 25 pos(Pinball/interconnects)	\$3.50
.100 Housings with pins 28 pos(Pinball)	\$4.50
.100 Spare pins / bag of 100	\$7.00
.100 Spare pins in bulk prepack of 500	\$30.00
.100 Polarizing keys 10/\$1.50 Bag of 100	\$11.00
Molex in-line .156 center Used by all mfrs at one time or another.	
.156 Straight headers various pos & type to select from	\$0.75
.156 Straight headers 24 position	\$2.00
.156 Right Angle headers 24 position	\$2.50
.156 Housing with pins 2 pos	\$0.15
.156 Housing with pins 3 pos(Monitor video)	\$0.25
.156 Monitor Set - 1 3 pos & 1 6 pos w pins	\$0.75

.156 Housing with pins 4 pos(WMs boards)	\$0.40
.156 Housing with pins 6 pos(Monitor video)	\$0.50
.156 Housing with pins 7 pos(WMs Boards)	\$0.65
.156 Housing with pins 8 pos(WMs Boards)	\$0.70
.156 Housing with pins 9 pos	\$0.75
.156 Housing with pins 10 pos(Monitor video)	\$0.80
.156 Housing with pins 10 pos (Trifurcon Pins)	\$1.20
.156 Housing with pins 11 pos	\$0.90
.156 Housing with pins 11 pos (Trifurcon Pins)	\$1.25
.156 Housing with pins 12 pos (Linear PS)	\$1.00
.156 Housing with pins 12 pos (Trifurcon Pins)	\$1.30
.156 Housing with pins 15 pos (Linear PS)	\$1.25
.156 Housing with pins 15 pos (Trifurcon Pins)	\$1.50
.156 Housing with pins 15 pos (AMP Heavy Duty)	\$2.50
.156 Housing with pins 18 pos(Linear PS)	\$1.75
.156 Housing with pins 18 pos(Trifurcon Pins)	\$2.30
.156 Housing with pins 19 pos(Linear PS)	\$1.85
.156 Housing with pins 19 pos(Trifurcon Pins)	\$2.40
.156 Housing with pins 20 pos(Linear PS)	\$1.95
.156 Housing with pins 20 pos(Trifurcon Pins)	\$2.50
.156 Housing with pins 24 pos (Linear PS)	\$2.25
.156 Housing with pins 24 pos(Trifurcon Pins)	\$3.00
.156 Obsolete Housings	\$0.50ea
.156 pins / bag of 100	\$7.00
.156 pins in bulk prepack of 500	\$30.00
.156 Trifurcon pins bag of 50	\$4.50
.156 Trifurcon pins bag of 100	\$8.50
.156 Trifurcon pins in bulk prepack of 500	\$37.50
.156 Polarizing keys 10/\$1.50 Bag of 100	\$11.00
.156 Pin Extractor	\$10.00
.156 Standard & Trifurcon Comparison	
Molex rectangular .062 D connectors Size Comparisons	
.062 Plug & receptacle 9 position with pins & sockets	\$2.00
.062 Plug & receptacle 12 position with pins & sockets	\$2.75
.062 Plug & receptacle 15 position with pins & sockets	\$3.50
.062 Spare pins only bag of 100	\$7.00
.062 Spare sockets only bag of 100	\$7.00
.062 Spare pins & sockets mix & match bag of 100	\$8.00
Molex manual pin/socket extractor .062 - Occasional Use	\$10.00

Molex spring loaded pin/socket extractor .062 - Industrial	\$20.00
Molex rectangular .093 connectors	
.093 Plug & receptacle 1 position w pin & socket	\$0.50
.093 Plug & receptacle 2 pos w pins & sockets (Monitor AC)	\$1.00
.093 Plug & receptacle 3 position w pins & sockets	\$1.25
.093 Plug & receptacle 3 position w pins/socs (Monitor AC)	\$1.50
.093 Plug & receptacle 4 position w pins & sockets	\$1.50
.093 Plug & receptacle 4 position Sq w pins & sockets	\$1.60
.093 Plug & receptacle 6 position w pins & sockets	\$2.00
.093 Plug & receptacle 9 position w pins & sockets	\$3.00
.093 Plug & receptacle 12 position w pins & sockets	\$4.00
.093 Plug & receptacle 15 position w pins & sockets	\$5.00
.093 6 Pos PCB Header (Pinball Bds)	\$2.00
.093 12 Pos PCB Header (Pinball Bds)	\$3.00
.093 pins only bag of 100	\$9.00
.093 sockets only bag of 100	\$9.00
.093 pins & sockets mix & match bag of 100	\$10.00
.093 Bag of 100 .093 Pins 18/14 Ga for larger wires	\$10.00
.093 Bag of 100 .093 Socs 18/14 Ga for larger wires	\$10.00
Molex manual pin/socket extractors .093 - Occasional Use	\$10.00
Molex spring loaded pin/socket extractors .093 - Industrial	\$20.00
All-in-one HT-1921 crimpers	\$16.00
Amp Connectors International Buyers: I am aware of your plight, but these are not the Molex 3191 series even though they look somewhat similar. These are equivalent to Molex 50-84-1xx0 & 2xx0.	
.084 Plug & receptacle 2 position w pins & sockets	\$0.75
.084 Plug & receptacle 3 position w pins & sockets	\$1.00
.084 Plug & receptacle 4 position w pins & sockets	\$1.25
.084 Plug & receptacle 6 position w pins & sockets	\$1.75
.084 Plug & receptacle 9 position w pins & sockets	\$2.25
.084 Plug & receptacle 12 position w pins & sockets xy mono	\$3.50
.084 Plug & receptacle 15 position w pins & sockets xy color	\$3.50
Amp 6 Pos Socket Housing w Socs	\$1.00
Galaga PCB power & video connector kit	\$2.25
Taito Power Connector	\$1.00
MCR 90412 PS connector kit	\$15.00
Amp MnL pins only bag of 100	\$8.00
Amp MnL sockets only bag of 100	\$8.00
Amp MnL pins & sockets mix & match bag of 100	\$9.00
Amp Manual Extraction Tool	\$20.00

Amp Spring Loaded Extraction Tool Best By Far!	\$50.00
Amp 10 Pos Plug & Socs	\$3.00
Amp 15 Pos Plug/Cap & Pins/Socs	\$7.00
Amp 24 Pos Plug/Cap & Pins/Socs	\$15.00
Amp 24 Above Bag of 50 Spare Pins & 50 Spare Socs	\$20.00
Amp Solder Tail Headers	
.084 3 Pos Pin Header	\$1.00
.084 6 Pos Pin Header	\$1.25
.084 9 Pos Pin Header	\$1.50
.084 12 Pos Socket Header	\$2.00
.084 12 Pos Pin Header	\$2.00
.084 15 Pos Socket Header	\$2.25
.084 15 Pos Pin Header	\$2.25
Quick Disconnect Terminals...for use with control panel switches	
QD Kit - 100pcs	\$12.00
Bag Of 100 #8 Red Rings	\$6.00
Bag Of 100 #10 Blue Rings	\$6.00
Bag Of 50 .110 Quick Disconnects	\$4.00
Bag of 100 Red Partially Insulated .187 QDs	\$6.00
Bag of 100 Red Partially Insulated .25(Coin switch)	\$6.00
Bag of 50 Red Fully Insulated .187 QDs (CP micros)	\$6.00
Bag of 100 Red Fully Insulated .187 QDs (CP micros)	\$11.00
Builder Pack Of 500 Fully Insulated .187 QDs (CP micros)	\$47.00
Bag of 50 Red Fully Insulated .25 QDs (Coin switch)	\$7.00
Bag Of 100 Blue Partially Insulated .187 QDs	\$6.00
Bag Of 50 Blue Partially Insulated .25 QDs	\$4.00
Bag Of 100 Blue Partially Insulated .25 QDs	\$6.00
Bag of 50 Blue Fully Insulated .187 QDs (CP micros)	\$7.00
Bag of 25 Blue Fully Insulated .25 QDs (Coin switch)	\$5.00
Bag of 50 Blue Fully Insulated .25 QDs	\$8.00
Spade connectors...to switcher PS terminals...bag of 50	\$6.00
In-line splice connectors bag of 50 red 22-18 \$7 bag of 100	\$10.00
In-line splice connectors bag of 100 blue 18-14 blue	\$10.00
Clear crimp-on wire nut splicers bag of 50	\$5.00
Cable Clamps & Ties - Bought Bulk Quantities To Cut Your Costs	
Cable Clamps Bag of 25 1/8"	\$3.50
Cable Clamps Bag of 25 3/16"	\$3.50
Cable Clamps Bag of 25 1/4"	\$3.50
Cable Clamps Bag of 25 3/8"	\$4.00
Cable Clamp Assortment Bag of 25 Each Size (100 Total)	\$10.00

Cable Clamps Bag of 100 1/8"	\$6.50	NLA
Cable Clamps Bag of 100 3/16"	\$6.50	
Cable Clamps Bag of 100 1/4"	\$6.50	
Cable Clamps Bag of 100 3/8"	\$7.00	
Cable Clamp Assortment Bag of 100 Each Size (400 Total)	\$20.00	
Black Cable Clamps Bag of 100 1/8"	\$6.50	
Black Cable Clamps Bag of 100 3/16"	\$6.50	
Black Cable Clamps Bag of 100 1/4"	\$6.50	
Black Cable Clamps Bag of 100 3/8"	\$7.00	
Black Cable Clamps Bag of 100 1/2"	\$8.00	
Larger Cable Clamp Sizes		
Cable Clamps Bag of 100 7/16"	\$7.00	
Cable Clamps Bag of 100 1/2"	\$8.00	
Cable Clamps Bag of 100 5/8"	\$8.50	
Cable Clamps Bag of 100 3/4"	\$9.50	
Cable Clamp Pan head screws 1/2" (50) Black	\$2.50	
Cable Clamp Pan head screws 1/2" (50) Shiny	\$2.50	
4" Cable Ties Bag of 100 Natural	\$2.50	
4" Cable Ties Bag of 100 Black	\$3.50	
8" Cable Ties Bag of 100 Natural	\$4.00	
11.5" Cable Ties Bag of 100 Natural	\$5.00	
4" Cable Ties Bag of 1000 Natural	\$12.00	
4" Cable Ties Bag of 1000 Natural + Tie Tool	\$16.00	
4" Cable Ties Bag of 1000 Black	\$13.00	
4" Cable Ties Bag of 1000 Black + Tie Tool	\$17.00	
Cable Clamp & Tie Builder Pack	\$35.00	
Cable Tie Tool	\$10.00	
Molex edge connector housings with full compliment of split pins. This obsolete line has pretty much dried up & what is left is priced in gold bars. We bought a pallet full of pins & all we could find of the housings to stretch them as much as possible, but they lasted less than one year & we are constantly looking for any pockets of either that may be hiding on backroom shelves. I wanted to forewarn y'all that as our stock runs out there will be a dramatic increase in pricing, if we can locate any, at all. There will be quite a trickle down effect on many of our parts & kits that use these connectors & pins, as well.		
10/20 Common on Atari games	\$7.00	
12/24 Common on Atari games	\$8.25	
15/30 Common on Atari games	\$10.00	
18/36 Common on Konami games	\$12.75	
22/44 Common on Bally/Midway games	\$15.25	
24/48 Common on Gottlieb games		

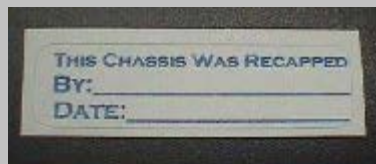
25/50 Common on Gottlieb games	\$18.00
28/56 Jamma	\$19.25
28/56 Jamma Labeled & Keyed	\$22.75
Molex split pins bag of 25	\$10.00
Molex split pins bag of 50	\$18.00
Molex split pins bag of 100	\$30.00
Molex split pin extractor	\$10.00
Molex JAMMA Polarizing Key	\$2.00
Molex Adaptor Aid	\$10.00
Solder Eyelet Edge Connectors	
10/20 SE EC	\$5.00
12/24 SE EC	\$5.00
15/30 SE EC	\$5.00
18/36 SE EC	\$5.00
18/36 ST EC	\$4.00
22/44 SE EC USA	\$6.00
28/56 SE EC Jamma	\$6.00
36/72 SE EC 8-Liner	\$6.00
36/72 ST EC Special	\$6.00
Fingerboards	
28/56 Jamma Fingerboards Type 1	\$3.00
28/56 Jamma Fingerboards Type 2	\$4.00
28/56 Jamma Fingerboards Type 3	\$3.50
Fingerboard Precuts State Size Needed 10/20 12/24 22/44	\$4.00
Adaptor Starter Kit Wire, Pre-soldered EC & Fingerboard Your Choice Of 18/36, 22/44 or 28/56 SE EC	\$10.00
PCB Edge Repair Kit 22/44	\$8.00
Stranded Hook-up Wire 100 ft hanks from 10K spools. Please select desired color/s from list of availables. Use 18GA for Power & 20GA for I/O - CP, Coin Door & Etc. 4/2010 - We've Sold Wire At A Loss For Nearly A Year Now Unfortunately, With The Wire Increases This Week We Need To Bring Our Prices Up Closer To A Break Even Point.	
100'-18GA red/orange/black/brown/blue/green	\$12.00
100'-20GA red/grn/blu/wht/blk/brn/gry/vio/yel/orn	\$10.00
Stranded hook-up wire 25 ft hanks from 10K spools. Specify Desired Color.	
25'-18GA red/orange/black/brown/blue/green	\$4.25
25'-20GA red/grn/blu/wht/blk/brn/gry/vio/yel/orn	\$3.75
25'-22GA red/gry/yel	\$3.25

Convenient Multicolor Wire Packs	
Bag of 20GA 10' x 10 colors (100' total)	\$12.00
Bag of 20GA 10' x 10 striped colors (100' total)	\$17.00
Bag of 18GA 10' x 6 colors (60' total)	\$12.00
Bag of scrap wires for adaptors	\$3.00
Super Shielded Multi-Conductor Cable Per/Ft	\$1.00
1/8" Black Heat Shrink Tubing Per/Ft	\$0.50
3/16" Black Heat Shrink Tubing Per/Ft	\$0.60
1/4" Black Heat Shrink Tubing Per/Ft	\$0.70
3/8" Black Heat Shrink Tubing Per/Ft	\$0.80

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[Monitor ID Page](#)

I noticed that many were saying they didn't remember when their monitor had been recapped last, so I bought in a 100K labels for you to date your cap jobs. We've been adding them to cap kits since April 2013 to help you keep a good record of your caps.



Cap Kits

Monitor Width Cap Kit NEW	\$10.00
Mylar Cap Kit In Clear Plastic Case	\$11.00
Bulk Pack Of Radial Electrolytics	\$40.00
Most Single Electrolytics Available From	\$1.00
Radial Cap Ten Packs From	\$2.50
Axial Cap Ten Packs From	\$2.50

Miscellaneous Kits Listed At Bottom Of Page.

A-One

AM-0316 13"/19" color	\$8.00
AP-0428	\$8.00
AP-0621 13"/19" color	\$8.00
AM-0629	\$8.00

Amplifone - Atari

A200009-01 19" color X-Y	\$20.00
A200011-01 25" color X-Y	\$20.00
A200009/11 color X-Y NO xsistors	\$10.00

Arachnid 6000

Kristel Display Cap Kit Used In Arachnid 6000	\$8.00
Omnivision Display Cap Kit Used In Arachnid 6000	\$10.00

Ceronix

1492	\$6.00
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Disco - Atari

2090DT-2B 19" color	\$6.00
AGM20M 19" med res color	\$8.00

Ducksan

Ducksan #55 Cap Kit	\$10.00
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Electrohome

GO5-801 19" B&W X-Y NO xsistors	\$5.00
GO5-802 19" B&W X-Y NO xsistors	\$5.00

GO5-805 15" B&W X-Y NO xsistors	\$5.00
GO5-801 19" B&W X-Y w xsistors	\$17.00
GO5-802 19" B&W X-Y w xsistors	\$17.00
GO5-805 15" B&W X-Y w xsistors	\$17.00
GO7-CBO 19" color most common	\$7.50
GO7-FBO 13" color common	\$7.00
G19-CCO 13" color	\$7.00
G19-CCO 19" color	\$7.00
G19-FCO 13" color	\$7.00
G19-FCO 19" color	\$7.00
Eygo- positions don't always match -	
19" Electrohome replacement	\$8.00
25" 826 version	\$8.00
27" 428 version	\$8.00
Goldstar	
2105A Cap Kit (Galaxy Dart)	\$10.00
Hantarex	
MTC 900/E 14"/19"	\$7.00
MTC 9000 10"/14"/20"/25"/28"	\$8.00
MTC Polo 10"- 33"	\$9.00
Hitachi	
Hitachi GMK 29FS3 Cap Kit	\$15.00
Imperial	
44-4050 25" Color	\$9.00
Jin Ruey	
M-703 13"/19" color	\$5.00
Kaga/TSK	
KZ-19V	\$7.00
KZ-20EN	\$7.00
KZ-20ES	\$7.00
Kagi	
(Warlords)13" color	\$7.00
Kortek	
KTA-915 color	\$9.00
K1-2-VOA 13"/19" color	\$9.00
KT-2502LF color	\$10.00
KT-2914F color	\$10.00
KT-2932 color	\$10.00
KTX-26 color	\$10.00
KTN-1401/ KTN2001 color	\$10.00

KT-2001SF color	\$10.00
KTW-N 26 color	\$10.00
Makvision	
Makvision CH-666 Cap Kit Per Schematic	\$13.00
Makvision M2929D Cap Kit Per Schematic	\$15.00
Makvision M2929D Neck Board Rev 2	\$5.00
288/A Chassis (Makvision/Pentranic/Others) 1425/1432/2425/2427/2432/2435/Others	\$14.00
Makvision 2725C1 Cap Kit Per Schematic	\$14.00
Matsushita - Atari	
TM201G color	\$6.00
Matsushita 14" color	\$7.00
TM202G 19" color	\$6.00
Merit	
Type 20	\$10.00
Type 55	\$10.00
Type 57	\$10.00
Type 58	\$10.00
Type 59	\$10.00
Type 66	\$10.00
Motorola	
XM501/701 B&W	\$5.00
M5000/7000 B&W	\$5.00
Nanao	
MS8-25FA 25" color	\$10.00
MS8-26SU 26" color	\$10.00
MS8-29FTB color	\$12.00
MS9-29A color	\$12.00
MS9-29T color	\$12.00
<u>Neotec</u>	
Neotec Combo Cap Kit 2700 series: If C118 and C119 are 1000uf35v use this kit!	\$10.00
Pincushion Cap Kit	\$5.00
Neotec Combo Cap Kit w Pincushion Cap Kit	\$13.00
NT-500DX High Temp Cap Kit	\$11.00
NT-S500 High Temp Cap Kit	\$13.00
NT-S501 High Temp Cap Kit	\$14.00
NT-2700/NT-2701/NT-2702NT-3500/NT-3501/NT-3506 If C118 and C119 are 100uf160v use this kit!	\$12.00
Pentranic	
1019 19" color Chassis With These Caps	\$7.00

1uf50v C105/C301/C403/C450/C451	
PC 1019 19" color Chassis With These Caps 1uf50v C301/C309/C311/C317	\$9.00
1025 25" color	\$7.00
288/A Chassis (Makvision/Pentranic/Others) 1425/1432/2425/2427/2432/2435/Others As Always, If Your Version Doesn't Have A Cap In A Position Or A Different Type Cap, Do <u>Not</u> Replace It	\$12.00
Promax	
C1000	\$7.00
M3400 14" color	\$7.00
M5000 19" color	\$7.00
M6300 25" color	\$7.00
Qnic	
CGM-2500 25" color	\$7.00
Rodotron	
Rodotron 666A Cap Kit	\$15.00
Rodotron 888A Cap Kit	\$10.00
Sampo	
KGR-1901 19" color	\$6.00
Sanwa	
Various models - caps only kits	\$8.00
Sanwa PM1718 Monitor	\$8.00
Sanwa PM1723C Monitor	\$8.00
Sanwa PM1745 Monitor	\$15.00
Sanwa 29E31S Monitor	\$16.00
Sanyo	
20EZ 13"/19" - Standard Industry Kit [20-Z2AW]	\$5.00
20EZ 13"/19" - Plus Kit with 9 more chassis caps	\$8.00
20EZ 13"/19" - Deluxe Kit [Plus & Audio Bd Kit]	\$12.00
Sanyo 14" color- Atari	\$8.00
Sanyo 14" color- Atari Full Electrolytic Kit	\$15.00
Nintendo Audio Board Repair Kit	\$5.00
Nintendo Video Inversion Parts Kit	\$5.00
Sega - Nanao	
MC1400S 14" color	\$8.00
MC2000S 20" color	\$8.00
MC2030S 20" color	\$8.00
Sharp	
XM-1801N 19" color- Nintendo	\$8.00
XM-2001N 19" color- Atari	\$8.00

B+ Filters For Above Kits (C706A & C706B)	\$4.00
Sharp Image	
OC-2021 19" color	\$8.00
OC-2022 19" color	\$8.00
SI-313 13" color	\$8.00
SI-319 19" color	\$8.00
SI-325 25" std res color	\$8.00
SI-325 25" med res color	\$9.00
SI-327 27" color	\$9.00
SI-629 DSR	\$15.00
SI-727R Dual Scan	\$15.00
KT-2725 25" Color	\$8.00
KTMF-2641M Color	\$10.00
Shinlee Corp	
EM201 14"/19" color	\$6.00
T & E	
K1-2 13"/19" color	\$6.00
TEC	
TM-600/623	\$9.00
TELCO	
KT-1403V (Megatouch)	\$12.50
Toei	
CM-A20HC 19" color (Centuri)	\$12.00
CM-F20U 19" color (Universal)	\$8.00
CM-R14 color (Crazy Climber)	\$12.00
GM-140 13" color (Space Invaders CT)	\$8.00
TC-HV18 Thanks to EM	\$8.00
TC-HV28LMJ 28" color	\$8.00
TC-V820/1 color	\$8.00
TC-V614H color	\$8.00
Toei B&W XY	\$8.00
Toei TC-A292N-3	\$16.00
Vectrex	
Vectrex Caps Only Kit	\$15.00
Vision Pro	
Vision Pro MTG-1901CN Cap Kit Per Schematic	\$10.00
Wei-Ya	
Models 13" - 28" color	\$8.00
Wells-Gardner	
D9200-D9202 Full kit less B+ filters	\$20.00

D9200-D9202 Full kit With B+ filters	\$26.00
D9204-D9205 Full kit less B+ filters	\$25.00
D9204-D9205 Full kit With B+ filters	\$37.00
D9400/D9800 High Temp Cap Kit	\$16.00
K3000 14" color	\$8.00
K4500 19"/25" color	\$7.50
K4600 19" color	\$7.50
K4700 13" color	\$7.50
K4800 13" color	\$7.50
K4900 19" color	\$7.50
K5500 25" color	\$7.50
K6100 19" color X-Y	\$30.00
K6100 19" X-Y less 6 output xsistors	\$10.00
K6100 Additional parts - NO Q604/704	\$15.00
K6100 Repair Package - Cap Kit + Additional Parts Kit + Q604/704	\$40.00
K6100 Repair Package Deluxe - Cap Kit + Additional Parts Kit + Q603/604/703/704	\$45.00
K7000 13"/19"/25" color	\$7.00
K7200/1 Color - Not For K7203	\$7.50
K7203 Color	\$10.00
K7302 Color	\$9.00
K7400/K7500 High Temp Cap Kit	\$12.00
K8000 Cap Kit	\$12.00
U3000	\$10.00
V1000 19"/23" B&W	\$5.00
V2000 15"/19" B&W X-Y no xsistors	\$5.00
V2000 15"/19" B&W X-Y w xsistors	\$17.00
WG Combo Kit (U2000/U5000/K7400/K7500)	\$12.00
Wico	
Sum-20C 19" color	\$9.00
Videomaster 10"/19" color	\$9.00
Videomaster 25" color	\$9.00
Zenith	
CD-19MRF06 19" color	\$7.00
<p>Couldn't find the cap kit you needed? LMK in email what brand & model you're looking for as we have nearly as many unlisted kits that are not so popular.</p> <p>The below kits are ones y'all have asked to have put up per lists & enough requests have prompted me to add them in here on the bottom. I'll try to add any that have been frequently requested as they come up.</p>	

Atari PCB Cap Kits	
<u>Asteroids PCB Cap Kit</u> NEW	\$5.00
<u>Asteroids Deluxe PCB Cap Kit</u> NEW	\$6.00
Battlezone PCB Cap Kit	\$7.00
Black Widow PCB Cap Kit	\$7.00
Canyon Bomber PCB Cap Kit	\$7.50
Centipede PCB Cap Kit	\$6.00
Dig Dug PCB Cap Kit	\$5.00
Gravitar PCB Cap Kit	\$6.00
Lunar Lander PCB Cap Kit	\$6.00
Major Havoc PCB Cap Kit	\$6.00
Millipede PCB Cap Kit	\$8.00
Missile Command PCB Cap Kit	\$7.50
Outlaw PCB Cap Kit	\$8.00
Pole Position/II PCB Cap Kit	\$12.00
Space Duel PCB Cap Kit	\$6.00
Space Invaders PCB Cap Kit	\$5.00
Star Wars PCB Cap Kit	\$8.50
Stunt Cycle PCB Cap Kit	\$10.00
<u>Tempest PCB Cap Kit</u> NEW	\$8.50
Bally/Midway Cap Kits	
<u>Galaga PCB Cap Kit</u> NEW	\$5.00
Galaxian PCB Cap Kit	\$7.50
Mortal Kombat 2 Sound Board Cap Kit	\$6.00
<u>Omega Race PCB Cap Kit</u>	\$7.50
Operation Wolf PCB Cap Kit	\$7.00
<u>Pac/Ms Pac PCB Cap Kit</u> NEW	\$7.50
Spy Hunter PCB Set Cap Kit	\$14.00
Tron PCB Set Cap Kit	\$13.00
<u>Bally 2518-32 Sound Board Cap Kit</u>	\$3.00
<u>Bally Squawk & Talk Cap Kit</u>	\$15.00
Bally Sound Board AS-2518-32 Cap Kit	\$3.00
Bally Sound Board AS-2518-50 Cap Kit	\$3.25
Bally Sound Board AS-2518-56 Cap Kit	\$5.00
Bally Dual Amp Bd A082-90910 Cap Kit	\$5.00
Bally Dual Amp Bd w Mixer A084-91648 Cap Kit	\$6.00
Sega Cap Kits	
Astro Blaster PS 800-0128 PCB Cap Kit	\$15.00
Carnival PS 800-0072 PCB Cap Kit	\$15.00
Sega G-80 Power Supply Cap Kit	\$15.00

Zaxxon Sound Board Fix Cap Kit	\$5.00
Misc Cap Kits	
CH-201 Monitor Chassis Cap Kit	\$7.00
Q*bert Sound Board Cap Kit	\$5.00
Phoenix PCB Cap Kit	\$5.00



1uf25v - R10	\$3.50
1uf50v - R10	\$3.50
1uf63v - R10	\$3.50
1uf160v - R10	\$3.50
1uf250v - R10	\$3.50
2.2uf50v - R10	\$3.50
2.2uf160v - R10	\$4.00
2.2uf250v - R10	\$4.00
3.3uf50v - R10	\$3.50
3.3uf160v - R10	\$4.00
3.3uf250v - R10	\$4.00
4.7uf25v - R10	\$3.50
4.7uf50v - R10	\$3.50
4.7uf63v - R10	\$3.50
4.7uf160v - R10	\$4.00
4.7uf250v - R10	\$4.00
10uf16v - R10	\$3.50
10uf25v - R10	\$3.50
10uf50v - R10	\$3.50
10uf63v - R10	\$3.50
10uf160v - R10	\$4.00
10uf250v - R10	\$4.00
10uf350v - R10	\$5.00
22uf25v - R10	\$3.50
22uf50v - R10	\$3.50

22uf250v - R10	\$5.00
33uf25v - R10	\$4.00
33uf50v - R10	\$4.00
33uf160v - R10	\$5.00
33uf250v - R10	\$7.00
47uf25v - R10	\$4.00
47uf50v - R10	\$4.00
47uf63v - R10	\$5.00
47uf100v - R10	\$5.00
47uf160v - R10	\$6.50
47uf250v - R10	\$8.50
47uf450v - R10	\$21.00
100uf10v - R10	\$3.50
100uf16v - R10	\$3.75
100uf25v - R10	\$4.00
100uf50v - R10	\$4.50
100uf160v - R10	\$10.00
100uf250v - R10	\$17.00
220uf10v - R10	\$4.00
220uf16v - R10	\$4.50
220uf25v - R10	\$4.50
220uf50v - R10	\$6.00
220uf100v - R10	\$11.00
330uf10v - R10	\$4.00
330uf16v - R10	\$4.50
330uf25v - R10	\$5.00
330uf50v - R10	\$6.50
330uf100v - R10	\$11.00
470uf10v - R10	\$5.50
470uf16v - R10	\$6.00
470uf25v - R10	\$6.50
470uf50v - R10	\$9.00
470uf63v - R10	\$11.00
1000uf10v - R10	\$5.00
1000uf16v - R10	\$5.50
1000uf25v - R10	\$6.00

1000uf35v - R10	\$8.00
1000uf50v - R10	\$10.00
2200uf25v - R10	\$10.00
2200uf35v - R10	\$11.00
2200uf50v - R10	\$16.00
2200uf63v - R10	\$21.00
3300uf35v - R10	\$16.00
4700uf50v - R10	\$51.00
10,000uf50v - R10	\$51.00

Happy Gaming.....

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Capacitor Ten Packs ---Axial List---

Updated 9/1/2016

My Grandson keeps telling me I need to make packs of the same value capacitors to get rid of ten million of them around here by his estimate. He's studying calculus, trig & logarithms now & I think he applied some part of those studies to come up with that ten million figure :-). Anyway, he's convinced me to give packs of ten a try starting with axials & has volunteered to make them up. It'll save you some arcade bucks over buying some of the smaller singles at a dollar apiece & the next time you need one you'll have it on hand.

1uf25v - A10	\$3.00
1uf50v - A10	\$3.50
1uf100v - A10	\$4.00
2.2uf50v - A10	\$3.50
4.7uf50v - A10	\$3.50
4.7uf100v - A10	\$4.00
4.7uf250v - A10	\$8.50
10uf25v - A10	\$3.50
10uf100v - A10	\$4.00
22uf50v - A10	\$3.50
33uf50v - A10	\$4.00
33uf160v - A10	\$11.00
33uf250v - A10	\$14.00
47uf16v - A10	\$3.50
47uf50v - A10	\$4.00
47uf100v - A10	\$5.00
100uf10v - A10	\$4.00

100uf25v - A10	\$4.50
100uf100v - A10	\$10.00
100uf160v - A10	\$19.00
220uf25v - A10	\$4.50
220uf50v - A10	\$6.00
220uf100v - A10	\$21.00
330uf16v - A10	\$4.50
330uf50v - A10	\$7.00
470uf10v - A10	\$5.00
470uf16v - A10	\$5.50
470uf25v - A10	\$6.50
470uf35v - A10	\$8.00
470uf50v - A10	\$9.00
1000uf10v - A10	\$7.00
1000uf16v - A10	\$8.00
1000uf25v - A10	\$8.50
1000uf35v - A10	\$11.00
1000uf50v - A10	\$11.00
2200uf25v - A10	\$11.00
2200uf35v - A10	\$21.00
2200uf50v - A10	\$26.00
2200uf100v - A10	\$36.00
3300uf35v - A10	\$31.00
4700uf16v - A10	\$21.00
4700uf25v - A10	\$26.00
10,000uf10v - A10	\$26.00
10,000uf16v - A10	\$31.00

Happy Gaming.....

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Closeouts

● Updated 8/11/13



Molex Single Sided Edge Connectors

.156 Housings - Used On Older Equipment PCBs

All Are Long Since Discontinued

\$.50 ea

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Bob'\$ Dollar \$tore

Updated 7/4/2011

OK... OK! You're right! It's hard to cut & paste these items, so I'll assign item numbers to them to make it easier.



Offset Cam - Can Be Used As In Or Out Offset On Most Locks Including The 641 Cam Lock Sets
Item DS100



Happ Replacement Ultimate 8-way Joystick Floating Actuator
Item DS101



Happ Replacement Ultimate 4-way Joystick Floating Actuator
Item DS102



Happ Ultimate Joystick Replacement Pivot Cylinder For Metal CP -\$1 Each - If You Use 2 As Pic'd For Wood CPs You'll Get 4 Times The Wear From Them By Rotating As Needed
Item DS103



Replacement 2" Guide Washer For Joysticks
Item DS104



Industrial 2MFD 250VAC Block Cap
Item DS105



Coin Switch Trip Wire Enclosure Guard
Item DS106



Pack of 10 7" Heavy Duty Cable Ties
Item DS107



Vertical Mount 2.5K Pot
Item DS108



~~Heavy Duty Aluminum AA Battery Holder-~~
Item DS109



~~2-Gram Packet Heat Sink Compound~~
Item DS110



~~Bag Of 15 Tyton #6-16-14 Heavy Duty Spade Connectors~~
Item DS111



~~24 Position Break-away .156 Header-~~
Item DS112



~~4 Happ Microswitch Replacement Nuts~~
Item DS113



~~Six Position 15 Amp Barrier Block~~
~~With Riveted Terminals~~
Item DS114



~~2 Two-Position 15 Amp Barrier Blocks - Just Stumbled Onto~~
~~Another Box Full Of These~~
Item DS115



~~Replacement Slide Switch With Bolts & Nuts For Panel~~
~~Mounting. Midway Games & Others. Drill Out The Rivets On~~
~~The One To Be Replaced & Bolt This One Up & You're In~~
~~Business Again :-)~~
Item DS116



~~2 Two-Inch 8-Ohm Tweeters-~~
Item DS117



~~3-5/8\"D 8-Ohm Speaker-~~
Item DS118



~~10K Pot~~
Item DS119

~~Cup Type Speaker Termination - Push-in Color Coded Terminals~~



Item DS120



RCA Type 2 Position Speaker Terminal Board
Item DS121



10 Watt CV Speaker Transformer - 70.7V - .62W Thru 10 Watt -
Wico PN 22-1002
Item DS122



~~4 Coin Mech Mounting Studs~~
New On Parts Page
Item DS123



Single Fuse Block - 3 Amp Fuse - Mounting Screw
Item DS124



Wire Wound Cement Resistor - 15 Watt .5 Ohm
Item DS125



2 TO220 Heat Sinks
Item DS126



14-16pin Dip Heat Sink - Got 1 Or 2 Heat Sinks Missing At 2A-
2B-2C-2D On Your Pac-Man Board? Here's A Good Radiating
Remedy.. Cool Clip On Type
Item DS127



12 Foot Coil Of Speaker Wire - Married White & White/Blue
Pair
Item DS128



Typical Lamp Cord - Married Pair 18ga Wire 24" to 44" In
Length - These Came With New Monitors & Power Supplies &
Were Unused
Item DS129



Green LED With 12" leads And Plug
Item DS130

10 Machine Screws 10/32 x 3/8 With Internal Tooth Washers -



Fit Most Computer Grade Capacitors Such As Big Blue
Item DS131



~~4 Quad Terminal Strips For Your Wiring Projects~~
Item DS132



Bag Of 5 Line Splicers - Tap Into Existing Lines For Power The
Neat Way
Item DS133



Bag Of 10 Ring Terminals - 18-14 With 1/8" Hole - Insulated
Item DS134



~~45K Volume Pot - A Good Replacement For Midway MK Series,
NBA & Others In That Era~~
New 50K on Parts Page
Item DS135



2 IC Sockets - Please Count # Of Legs... Rather Than For
MB2845 Chip - 8-14-16-18-20-22-24-28-40-64
Item DS136



~~10 Replacement Snap-On Connectors For 9-volt Batteries~~
Item DS137



Do You Ship Monitors Or Pic Tubes? These Are Pin Protectors
For The Tube After You Remove The Neck Bd - Per Pair
Item DS138



5mm x 20mm Minature Fuse Holder
Item DS139

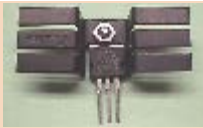


~~Two D44 Cherry Switches - .250 Terminals~~
Item DS140



1K Pot - Works Nicely On Atari A/R II Boards
Item DS141

TO220 Heatsink W Bolt & Nut - Xsistor Not Included



Item DS142



Cherry Switch - .187 Terminals
Control Panel Joystick & Button Switch
Item DS143



10 6-32 x 2" Philips Head Machine Screws
Item DS144



Used Taito "D" Small PCBs 3"x3"
2x C1061, 555, 7400, C1815
Item DS145



Microswitch Rated 21A @ 250VAC W .25 Tabs
Item DS146



Automotive Type Fuse Holder With 3A Fuse & Cover
Item DS147



~~10 Yellow 12-10 Butt Connectors~~
Item DS148



~~Panasonic 3 Volt Battery BR2330 Solder-In Type~~
Item DS149



Used Spring Steel Interlock Switch Holder
Item DS150



20 Partial Insulated 22-18 .250 QDs
Item DS151



Coin Cell Battery Holder For CR2325 Batteries
Item DS152

8 Blue 18-14 Fully Insulated .250 QDs
Item DS153



~~Coin Door Lock Cam With Top & Bottom Dead Latches - Must Have Door With Guides Top & Bottom~~
Item DS154



Used Interlock Switch
Item DS155



2 Heavy Duty Leaf Button Springs
Item DS156



1 1/8" Square Stick On Heat Sink - Great For Cooling A Bridge Rectifier
Item DS157



~~2" Cam - Fits Most Locks Including The 641 Lock Sets~~
Item DS158



~~2 3/4" Cam - Fits Most Locks Including The 641 Lock Sets~~
Item DS159



1 1/8" Cam - Fits Most Locks Including The 641 Lock Sets
Item DS160



~~Cam Lock Anchor Plate~~
Item DS161



Test Switch
Item DS162



20 Spring Nuts For Screw Mounting
Item DS163



~~20 Heavy Duty #10 5/8" Hex Head Screws - Used Inside Cabs To Secure Walls~~
Item DS164



Box Of 10 #55 Lamps
Item DS165



Bag of Ten .156 Trifurcon Pins
Item DS166



20 Black Phillips Washerhead 1" Wood Screws
Item DS167



Packet Of 60/40 Solder
Item DS168



Trimmer Pot - Choice 100 Ohms Or 2K Ohms - Same Footprint
As K7000 Remote Board
Item DS169



Horizontal Pot - Choice 1K Or 5K Ohm - Same Footprint As
K7000 Remote Board
Item DS170



C106M Silicon Controlled Rectifier (SCR)
Item DS171



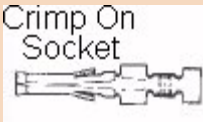
Bag of Ten .100 Molex Pins
Item DS172



Bag of Ten .156 Molex Pins
Item DS173



Bag of Ten .062 Molex Pins
Item DS174



Bag of Ten .062 Molex Sockets
Item DS175



Bag of Ten .084 Amp Pins
Item DS176



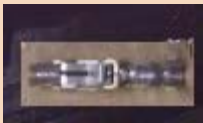
Bag of Ten .084 Amp Sockets
Item DS177



Bag of Ten .093 Molex Pins
Item DS178



Bag of Ten .093 Molex Sockets
Item DS179



~~Bag of Four Molex Jamma Split Pins~~
Item DS180



Bag of Eight .187 Fully Insulated .187 Quick Disconnects
Item DS181



~~100 Cable Ties Choice of Blu/Yel/Blk - Low Grade Import - Not Professional Grade~~
Item DS182



Bag Of Eight PS Narrow Spade Connectors
Item DS183



22 Pin Machine Socket For 5101 Ram
Item DS184

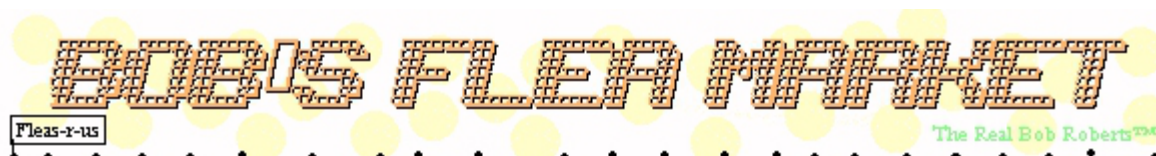


Wico 8-way Microswitch Joystick Actuator
Item DS185

Most of these items are in limited supply and not something that I will restock. When they're gone, they're gone :-)

Happy Gaming.....

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Most of these items are one-of-a-kind and sold as-is flea market style. I don't even remember what many of the parts kicking around were for, so if it doesn't have info with it, your guess will probably be better than mine, if you have something to compare it to. I'm sure some items will be golden treasures, while others will make good paperweights, but hopefully, at least some good recyclable parts will abound.... and just maybe, some part you have been looking for will be pic'd here. Since it is a flea market, I am going to post things other than coin-op related items, as well. I've got 40 years accumulation of junk that has to go, so don't be surprised to see my first born's baby carriage on this page :-)

Updated 9/15/2016

All Sales Final - No Warranties - As-is - Caveat Emptor

This page is comprised of 100% junk, but just maybe YOUR treasure is here!

Happy Hunting...	
1 Pac Cab Handle - 1 Broke in Shipping :-)	\$2.00
One Used Jamma Harness	\$5.00
Bally Lamp Driver	\$10.00
Half Dozen Flyers	\$1.00
Bag of Aluminum PCB Spacers	\$5.00
Used 36/72 Split Pin Connector	\$2.00
Taito Linear Power Supply	\$8.00
75' Cat5 Patch Cable	\$8.00
Pac Reunion Joystick	\$15.00
A/R II-01 Bd	\$12.00
Box of Various Used Neck Bds	\$14.00
Rastan PCB	\$8.00
Tron Video Bd	\$12.00
Tron Super CPU Bd	\$12.00
Box of Wires & Connectors - Nintendo & Others	\$10.00
Isolation Transformer	\$18.00
MK III P12 Cable	\$5.00
Bag of 40 Pin IC Sockets	\$5.00
Box of Bally/Stern Displays For Parts	\$10.00
Set of (4) 3" Casters (NOS)	\$10.00
Box of Various Types of Microswitches	\$12.00
Ms Pac CP	\$10.00
Two Switchers	\$8.00
Matsushita Neck Bd Parts	\$5.00
Cassette Deck [Amplifier Feed]	\$12.00

1000' Cat 5 Cable	\$35.00
18" Fluorescent Fixture	\$8.00
Digital Multimeter	\$15.00
PS Jig for Atari System I PCBs	\$5.00
Grayhound Poker PCB Jig	\$5.00
Logic Generator & Probe	\$8.00
Digital Meter	\$1.00
Jig Kit to Atari AC Power Supply	\$8.00
K4600 Sat Boards [8 Pieces]	\$40.00
Atari/Happ Odds & Ends	\$35.00
Bag of Misc Lock Pieces	\$3.00
8 NOS Wico Joystick Leaf Switches	\$24.00
Super Glob Kit for Pac Bd	\$50.00
Misc Mounting Hardware	\$2.00
20EZ Cage	\$1.00
Battery Holders	\$1.00
6" Speaker	\$4.00
Lit Button Assembly	\$1.00
Gottlieb Adaptor/Filter Bd	\$4.00
Gottlieb Bd	\$1.00
Patco Wire Stripper Adaptor [3v/400ma]	\$4.00
Parts PCB	\$1.00
K4600 Vid/Sync Bd	\$14.00
Gottlieb Switch Matrix Box	\$10.00
Monitor Chassis For Parts	\$5.00
Monitor Parts Chassis	\$5.00
Galaga Bd Set For Parts	\$17.00
Bench Power Supply Jig	\$10.00
Ancient Jukebox Caddy w A Few Ods & Ends	\$5.00
NOS Keyboard Circa 1980	\$4.00
Nintendo Isolation Xformer	\$20.00
5 Pinball Playfield Clear Mylars	\$7.50
Black Project Box	\$2.00
Signal Tracer	\$2.00
Hodge Podge	\$5.00
Dynamo Labeler	\$2.00
5K & 50K Pots	\$3.00
8-Liner Manual & Notes	\$2.00
Polaroid Camera	\$9.00
Juke PS Jig	\$10.00

Super Bagman CPU Adaptator	\$7.50
18" Open Face Fluorescent Fixture Just 2 left	\$8.00
Etcher	\$3.00
3 Amp Meters	\$3.00
45 RPM Strobe Disc	\$2.50
Video Color Inverter	\$4.00
Project Box	\$3.00
Box Of Bill Acceptor Cleaning Cards	\$5.00
8 Conductor Cable	\$1.00
Williams Display Tester	\$4.00
Nintendo Inverter Jig	\$18.00
90412 Power Supply	\$10.00
Knobs - Each	\$2.00
Slide Switches & Volume Pots	\$5.00
Selector Switches	\$5.00
Hodge Podge 607	\$4.00
Optics	\$5.00
Pushbutton MOMs	\$5.00
Eprom Programmer	\$40.00
CRT Tester/Rejuvenator	\$75.00
Super Pac-Man Parts Set PCBs	\$15.00
Streetfighter 2 Bootleg Parts Bd	\$5.00
Ring King Parts Bd	\$5.00
Pole Position CPU Parts Bd	\$10.00
Satin's Hollow Video Generator Parts Bd	\$5.00
SPM Bd Set For Parts	\$15.00
Williams CPU Bd	\$15.00
Bally Rectifier Bd	\$4.00
Taito CPU	\$3.00
Pole Position II Video Bd	\$15.00
MVS Neo-Geo Metal Slug X	\$25.00
3 Electric Key Lock Switches	\$12.00
Box of Coin Windows	\$18.00
6 Padlocks Keyed Alike w 2 Keys Each	\$18.00
Pair of Nintendo K7450 Locks w Keys	\$15.00
Pair of Nintendo K6510-CT Locks w Keys	\$18.00
MVS Neo-Geo Samurai Shodown	\$18.00
Zero Force Insertion Socket Set	\$7.50
4 x 1 ohm 50 watt Load Resistors	\$5.00
NOS SMS Hi-Lo Joker Poker Monitor Plexi	\$10.00

Nintendo 20EZ Chassis	\$40.00
Amplifone Deflection Bd	\$25.00
Super Glob Marquee	\$20.00
Bally Solenoid Bd	\$10.00
Bally Lamp Driver	\$10.00
Williams Main & Rom Bds	\$25.00
Pair of 20EZ Inverters	\$35.00
Pole Position Video Bd	\$10.00
Williams Rom Bd	\$15.00
Williams Rom Bd	\$20.00
Bally Paragon Sound Bd	\$14.00
Shielded Nintendo Isolation Transformer	\$20.00
Service Panel	\$2.00
G05-802/805 Manual	\$7.00
Rowe OBA Bill Acceptor Manual	\$7.00
G07 Manual	\$7.00
Replay March 1989	\$5.00
Replay August 1989	\$5.00
Cab AC Outlet	\$5.00
WG P758 Remote Board	\$20.00
Pair of Coin Mech Holders	\$10.00
Crimper Bench Jig	\$30.00
Gorgar Speech Board(1 Left)	\$20.00
Pin Power Supply	\$7.50
Sega Daytona Dual Audio Amp	\$15.00
K6510 Nintendo Key	\$4.00
MV-1A 1-Slot Service Manual	\$1.00
Rockola 1428 Cylinder Insert	\$5.00
12 Used Labeled Short White Leaf Buttons	\$5.00
25/50 x .100 Solder Eyelet Connector	\$3.00
Super Joystick Accessory Kit	
Zaxxon Mounting Plate or Redrill To Suit	\$6.00
2 Double Button Package	\$5.00
16' Fused Married Pair 2/18 W 3A Fuse	\$1.50
AC Power On Indicator	\$4.00
Thermal Wire Stripper New	00.00
Thermal Wire Stripper Replacement Blade	\$7.00
Thermal Wire Stripper Replacement Guide	\$5.00
Thermal Wire Stripper Replacement Blade PTS-20	\$7.00
WG Cab Video To Nintendo Monitor Adaptor	\$5.00

1 3/8" Fort Lock	\$4.00
2-way Small Lock Cam	\$1.00 ea
2-way Large Lock Cam	\$1.00 ea
3" Trakball Support Plate	\$1.50
Mars VFM5S Mounting Kit	\$10.00
Super Joystick Guide Washer	\$1.00
Various Books From	\$1.00
Ardac Bill Acceptor Jig	\$10.00
Unkown Bill Acceptor Jig	\$10.00
OEM Atari Metal TB Encoder Wheel	\$4.00
17" AC Extension Cord	\$2.00
54 Used Sams Photofacts	\$25.00

I sold all my Replay & Play Meter mags in sets up till the mid 80's & they just stopped selling at that time, so I removed them from the site. There seems to be renewed interest, if only for certain issues, so I thought I would list what I have left of each as singles for \$3.00 each. Buy just the one that you're interested in or the year set for \$35 which would include the directory issue in most years.

These have stopped selling again, so whatever is left are \$1 each until gone! They hold an abundance of pics, history, service info & tech stuff that will almost certainly answer many Qs you have.

Replay Mags	\$3.00 Ea
Play Meter Mags	\$3.00 Ea

Happy Gaming.....

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[Updated 1/25/2015](#)

1/25/15

Our harness maker has been inundated for the last three months with all the custom pieces... harnesses, adaptors, ribbon cables & such & we have been forced to bump pieces to the front of the line when payment has been received... out of normal order of first come first serve. We have been continuing the struggle trying to get back on track without much success. Another hindrance is people ordering specific harnesses, or adaptors, & then backing out when they find their pcb is fried, cab unsalvageable or just not worth their effort to continue with the restoration. All the time spent on these pieces just detracts from available time in making the things you do want. As a result of this, at least temporarily, all custom pieces will be made upon receipt of payment only.

Custom Harnesses Also Available Starting At \$15.00	
49-Way .100 x 12 Joystick Harness	\$12.50
49-Way .156 x 12 Joystick Harness	\$12.50
60-IN-1 Trackball Interface Harness	\$12.00
Economy JAMMA Harness	\$32.00
Super-Super Economy JAMMA Harness Kit	\$45.00
Fully Loaded JAMMA Harness	\$36.00
Super-Super Fully Loaded JAMMA Harness Kit	\$49.00
Neo Geo/JAMMA Harness	\$36.00
Super-Super Neo Geo JAMMA Harness Kit	\$49.00
12" Jamma Extension Harness	\$30.00
3' Jamma Extension Harness	\$45.00
5' Jamma Extension Harness	\$55.00
DC Pac/Ms Pac Harness	\$45.00
DC Pac/Ms Pac Harness Kit	\$60.00
Bootleg Pac/Ms Pac Harness	\$35.00
Bootleg Pac/Ms Pac Harness Kit	\$50.00
Galaga Harness	\$45.00
Galaga Harness Kit	\$60.00
Bootleg Galaga Harness	\$35.00
Bootleg Galaga Harness Kit	\$50.00
Arkanoid Harness	\$40.00

Asteroids Harness	\$40.00
Bosconian Harness	\$40.00
Burgertime Harness	\$40.00
Crazy Climber Harness	\$40.00
Frogger Harness	\$40.00
Front Line Harness	\$40.00
Donkey Kong Harness	\$40.00
Donkey Kong Jr Harness	\$40.00
Donkey Kong 3 Harness	\$40.00
Hypersports Harness	\$45.00
Ikari Warriors Harness	\$40.00
Mario Bros Harness	\$40.00
Pacland Harness	\$45.00
Phoenix Harness	\$40.00
Popeye Harness	\$40.00
Taito (Specify Game) Harness	\$40.00
Track 'n Field Harness	\$45.00
Vanguard Harness	\$40.00
Pac/Ms Pac Control Panel Harness	\$35.00
JAMMA Plus Harness Complete	\$20.00
JAMMA Plus Harness CP Half Only	\$16.00
JAMMA Plus Harness PCB Half Only	\$10.00
Konami Harness - Generic	\$40.00
Konami 3 & 4 Player Harness	\$35.00
Dungeons & Dragons 3 & 4 Player Harness	\$35.00
Video Harness	\$6.00
Video/Sync Harness w Jamma Pins	\$7.00
Video/Sync Harness w Galaga Termination	\$8.50
Video/Sync Harness For Bootleg Galaga	\$7.00
Video/Sync Harness w MCR Termination	\$10.00
Video/Sync Harness w Super Pac Termination	\$8.50
Video/Sync Harness w Tron Termination	\$10.00
Video/Sync Harness w WMs Termination	\$7.00
Taito "H" Power Cable	\$12.50
AC Line Tap Harness w Molex Connector	\$9.00
AC Line Extension Harness	\$5.00
Power Supply Tester Harness	\$20.00
Atari A/R Adaptor To Basic PS Test Harness	\$7.50
Galaga Adaptor To Basic PS Test Harness	\$7.50
Std Switcher Adaptor To Basic PS Test Harness	\$7.50

Williams Adaptor To Basic PS Test Harness	\$7.50
Each Adaptor Above When Purchased With PS Test Harness	\$5.00
Frogger Replacement Volume Control & Cable	\$10.00
Williams Classic Replacement Volume Control & Cable	\$12.00
Williams JAMMA Replacement Volume Control & Cable	\$10.00
Williams Ribbon Cable Main PCB to Rom PCB	\$10.00
Williams Ribbon Cable Main PCB to Speech PCB	\$10.00
Williams Ribbon Cable Main PCB to Interface PCB	\$9.00
Atari/Happ TB Replacement Harness	\$9.00
Trackball Illumination Harness	\$6.00
10' Isolation AC Monitor Extension Cable	\$10.00
10' RGB Monitor Extension Cable	\$20.00
10' V2000/G05-802/05 Monitor Extension	\$35.00
10' K6100 Monitor Extension	\$40.00
V2000 Monitor To G05-801 Wired Cabinet Adaptor Harness	\$20.00
G05-801 Monitor To V2000 Wired Cabinet Adaptor Harness	\$20.00
XY Output Harness Short	\$12.50
XY Output Harness Long	\$12.50
Interconnect Cable	\$10.00
6 20ga JAMMA Replacement Wires With Pins	\$4.00
6 20ga JAMMA Replacement Striped Wires With Pins	\$5.50
6 18ga JAMMA Replacement Wires With Pins	\$6.00
MVS -5 volt Add-on Cable	\$2.00
Replacement Atari Interconnect Cable - 24 Pos ILs .156	\$20.00
RIBBON CABLES	
20 Pos To 20 Pos x 10"	\$5.00
20 Pos To 20 Pos x 15"	\$7.50
20 Pos To 20 Pos x 20"	\$9.00
26 Pos To 26 Pos x 15"	\$8.50
26 Pos To 26 Pos x 19"	\$9.00
26 Pos To 26 Pos x 32"	\$11.00
34 Pos To 34 Pos x 15" - Other Lengths Available	\$9.50
40 Pos To 40 Pos x 15" - Other Lengths Available	\$10.50
50 Pos To 50 Pos x 1.5"	\$3.00
50 Pos To 50 Pos x 4" - Other Lengths Available	\$4.00
<u>RIBBON KEY CHART</u>	
Connector Kits To Use In Conjunction With Any Of The Game Harness	
Midway Deluxe Harness Accessories Kit	\$15.00
Super-Super JAMMA Accessories Kit	\$15.00

Happy Gaming.....

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Happ Ultimate

[Ultimate Stick vs Competition Stick](#)

Ultimate Black Stick	Sold Out
Ultimate Blue Stick 10 Left	\$3.00
Ultimate Green Stick	\$3.00
Ultimate Yellow Stick	\$3.00
Ultimate Red Stick	Sold Out
Ultimate Guide Washer	Sold Out
Ultimate 8-way Actuator	\$1.00
Ultimate Standard Spring	\$1.00
Ultimate 4-way Actuator	\$1.00
Ultimate 8-way To 4-way	\$4.00
Ultimate Heavy Duty Spring	\$2.00
Ultimate Microswitch 4-Pack	\$4.00
Ultimate Pivot Cylinder	\$1.00
Ultimate E-Clip	\$0.50

Happ Competition

Competition Black Stick	\$3.00
Competition Blue Stick	\$3.00
Competition Green Stick	\$3.00
Competition Yellow Stick	\$3.00
Competition Red Stick	\$3.00
Competition Guide Washer	\$1.00
Competition Standard Spring	\$1.00
Competition Heavy Duty Spring	\$2.00
Competition Microswitch 4-Pack	\$4.00
Competition E-Clip	\$0.50

Happ Super

Super Black Stick	\$3.00
Super 4/8-way Actuator	\$1.00
Super Pivot Cylinder	\$1.00

Super Microswitch 4-Pack	\$5.00
Super E-Clip	\$0.50
Midway	
Centering Grommet Pac- Ms Pac-Bosconian- Rally-x- Burger Time - Others	\$11.00
Pac Reunion Stick Choice Standard or Tall	\$4.50
Wico	
Wico Black Stick	\$3.00
Wico Blue Stick	\$3.00
Wico Orange Stick	\$3.00
Wico Powder Blue Long Stick	Sold Out
Wico Plum Long Stick	Sold Out
Wico Red Stick	Sold Out
Wico Matte Red Stick	\$3.00
Wico Guide Washer	Sold Out
Wico Spring	\$1.00
Wico 8-way Microswitch Actuator	\$1.00
Replacement 4-way Leafswitch Actuator	\$1.00
Replacement 8-way Leafswitch Actuator	\$1.00
Replacement Leafswitch 4-Pack	\$4.00
Single Replacement Leafswitch	\$1.25
Wico E-Clip	\$0.50

2003

Jukebox Needles & Parts

The Real Bob Roberts

Updated 5/15/2016

Other Jukebox Odds And Ends	
3 Denomination Coin Mechs 1 Left	\$12.00ea
10 Inch Replacement Speakers	\$10.00ea
Nsm BDW8300 Thermal Sensors	\$8.00ea

Jukebox Keys & Other Common Keys	
Seeburg Jukebox	
F205	\$4.00ea
F221	\$4.00ea
F264	\$4.00ea
F278	\$4.00ea
F279	\$4.00ea
F282	\$4.00ea
F291	\$4.00ea
F293	\$4.00ea
F313	\$4.00ea
F314	\$4.00ea
F330	\$4.00ea
F333	\$4.00ea
F336	\$4.00ea
G202	\$4.00ea
G219	\$4.00ea
G245	\$4.00ea
G324	\$4.00ea
L290	\$4.00ea
S017	\$4.00ea
S102	\$4.00ea
S162	\$4.00ea
S170	\$4.00ea
Wurlitzer Jukebox	
RW47	\$4.00ea
RW49	\$4.00ea
RW75	\$4.00ea
RW80	\$4.00ea

RW85	\$4.00ea
RW95	\$4.00ea
RW110	\$4.00ea
RW105	\$4.00ea
RW100	\$4.00ea
AMI/Rowe Jukebox	
C092A	\$4.00ea
C256A	\$4.00ea
C33A	\$4.00ea
C415A	\$4.00ea
C440A	\$4.00ea
C70A	\$4.00ea
F486	\$4.00ea
F592	\$4.00ea
F593	\$4.00ea
K7450	\$4.00ea
P600	\$4.00ea
R1303	\$4.00ea
NSM Jukebox	
2C2608	\$4.00ea
2H0010	\$4.00ea
Common Numbered Keys	
E002 Single Bitted Keys	\$3.00ea
Rocket Keys (100's) # Needed ?	\$2.00ea

Junk PCBs

Junk PCBs to practice soldering on, cannibalize what parts are left or perhaps even salvage a board you might need.

Take Your Pick Of The Junk Boards At \$2.00 Each!

Updated 5/4/2016

[Junk 30](#)

[Junk 36](#)

[Junk 37](#)

[Junk 48](#)

[Junk 12](#)

Happy Gaming... [The Real Bob Roberts™](#) Happy Gaming...

Klearance Korner



Updated 3/25/16

US Games



Pick Up Only - Used US Games Counter Tops
All Not Working - Game Boards OK
PS or Hantarex 10" Monitor Fault With Each
All Three As A Package Deal

~~\$250.00~~
~~\$150.00~~
~~\$75.00~~

[Screen Shots](#)



54 Used Sams Photofacts

Just 1 Download Online Would Cost You \$5

~~\$150.00~~
~~\$25.00~~

[Site Index](#)



I guess that nearly everyone knows what lagniappe is by now, and that we routinely practice it, but, just in case there is one person out there that is still in the dark about lagniappe, it equates to what some call a freebie, gift or a gratuity.

Alice & I always guess at something that you may need or want & sometimes it doesn't work out well, e.g., we might toss in a package of leg levelers only to hear back that the person is into MAME & does not have any arcade cabs to install them on. This is why we like to have something that is enjoyed by all regardless, such as the brownies & Mardi Gras items that we add during the season.

One day last week we were trying to think of something for lagniappe for a specific order & during this "staff" meeting it was suggested that I make a page for lagniappe items from stock that you could pick from, thus making certain that the item was useful in your case. Of course, we always added lagniappe without rhyme nor reason, so you might have got a flyback xformer along with the cap kit you ordered for your monitor, or you may have never received any lagniappe outside of the non-arcade items :- (For this reason it was decided if we tried this that we would have to have some guidelines in order for it to work. Obviously, we couldn't have everyone buying a cap kit requesting a color monitor for lagniappe, so Alice came up with making certain items available for specific dollar amount categories, which is what I will attempt to do for a trial basis & we'll see how it goes.

Janice, being a pic person, insisted that I put pics up for the choices. I told her I'd have to label or number them in some way for selection & that some may not know what the pic is of, to which she replied,
"If they don't know what it is, they don't need it" :-)

In order to get the lagniappe item of your choice you must get a total of your order without the shipping & choose from the appropriate category below. Just include the caption under the item you chose when you place your order & we'll include it.

\$50.00 To \$99.00



Lagniappe 1



Lagniappe 2



Lagniappe 3



Lagniappe 4



Lagniappe 5



Lagniappe 6



Lagniappe 7



Lagniappe 8



Lagniappe 9

\$100.00 To \$199.00



Lagniappe 10



Lagniappe 11



Lagniappe 12



Lagniappe 13



Lagniappe 14



Lagniappe 15



Lagniappe 16



Lagniappe 17



Lagniappe 18

\$200.00 & Over



Lagniappe 19



Lagniappe 20



Lagniappe 21



Lagniappe 22



Lagniappe 23



Lagniappe 24



Lagniappe 25



Lagniappe 26



Lagniappe 27

We still buy in odd items to toss in as lagniappe & some draw some email Qs, but two recent ones are drawing more than the usual, so I thought I'd put the answers right here to point to.

The first one is this item:



This is first of all a screwdriver. It has a screw in the end of the handle where you can attach a wire with an alligator clip to clip to ground. Then you can probe with the screwdriver for voltage being present from 100 volts to 500 volts.... stamped on the handle. If voltage is present the neon lamp inside the handle will glow. On the bench this can be handy without the wire attached for checking a flyback to see if it is generating an output when you have a black screen symptom. Simply holding the insulated screwdriver shaft place the side of the handle with the lamp inside in close proximity to the side of the flyback & the lamp will glow if the flyback is working.

Next one is a little easier:



A toothbrush... what does Alice think I need to pay more attention to oral hygiene,
or what?

No... these are for cleaning inside your cab... from monitor crevices to around IC
legs & components on a PCB.

Leaf Buttons

A couple of you have asked to have the leaf buttons listed by color & type, so that the control panel comes out uniform & I've been working on it piecemeal, as usual. There are two types available... the NOS Wico type buttons with the e-clips on the bottom that hold the button in & the snap together repros. Rather than try to get a pic of the whole button depicting the type, I'm going to do just the tops to give you a better idea of the color & then list the type that it is.











I must be crazy... just stumbled onto another huge stash of the old e-clip type short leaf buttons & I bought them... like I need more! They are now available onsite at \$1 each & are all of the same mold & go together nicely.

Colors available are:
Green Apple - Candy Apple Red - ~~Pure White~~
~~Midnight Black~~ ----- Midas Gold
Pal Nuts Needed & Sold Separately 5/\$1

The Real Bob Roberts™

[Two Tone Short Snap Leaf Buttons - \\$1.25ea](#)

Leaf Buttons					
Pic	Part Ref	Color	Type	Length	Price
	BSRR	Red	Snap	Short	\$1.00
	BSGR	Green	Snap	Short	\$1.00
	BSBR	Blue	Snap	Short	\$1.00
	BSPR	Lavender	Snap	Short	\$1.00

					
	BSBKR	Black	Snap	Short	\$1.00
	BSLYR	Pale Yellow	Snap	Short	\$1.00
	BSLBR	Powder Blue	Snap	Short	Sold Out
	BSMBR	Medium Blue	Snap	Short	\$1.00
	BSWR	White	Snap	Short	\$2.00
	BSYR	Yellow	Snap	Short	\$1.00
	BSOW	Orange	E-clip	Short	\$1.00
	BSOTW	Trans Orange	E-clip	Short	\$1.00

					
	BSGTW	Trans Green	E-clip	Short	\$1.00
	BSRTW	Trans Red	E-clip	Short	Sold Out
	BSWW	White	E-clip	Short	Sold Out
	BSLBW	Light Blue	E-clip	Short	\$1.00
	BSGW	Galaga Gold	E-clip	Short	\$1.00
	BLDLR	Dark Lavender	Snap	Long	\$1.00
	BLLR	Lavender	Snap	Long	Gone
	BLDOR	Dark Orange	Snap	Long	\$1.00

					
	BLGR	Green	Snap	Long	\$1.00
	BLLBW	Light Blue	E-clip	Long	Gone
	BLBW	Blue	E-clip	Long	\$1.00
	BLLLBW	Lightest Blue	E-clip	Long	Gone
	BLBKW	Black	E-clip	Long	\$1.00
	BLOTW	Trans Orange	E-clip	Long	\$1.00
	BLGTW	Trans Green	E-clip	Long	\$1.00
	BLDGW	Dark Green	E-clip	Long	\$1.00

					
	BLRW	Red	E-clip	Long	\$1.00
	BLGYW	Gray	E-clip	Long	\$1.00
	BLOW	Orange	E-clip	Long	\$1.00
	BLWW	White	E-clip	Long	Sold Out

[Recently Purchased Short E-clip Buttons \\$1.00 Each](#)

Happy Gaming.....

<p>Seems like the sales stopped in the 90's, so I guess Jamma isn't as popular, so these are at half price for now. I guess the desire comes with every decade, so maybe these 90 issues will become popular later on.</p> <p>\$1.50 Each Or 12/\$12.00</p>	
Replay Mags	\$1.50 Ea
Play Meter Mags	\$1.50 Ea
<p>These mags, as well as, any of the books listed here Books can be shipped at USPS book rate/media rate which is much less than parcel post & only takes a few days more for delivery.</p>	

Manuals

Updated 7/4/11

I still have 7 cases of various manuals & schematics cluttering up the place, so I thought I would toss a few up here & see if there is any interest in them. If there is I'll try to add a few more every time I get a minute to spare.

[Large WG K4915 Schematic - \\$2.50](#)

[Stargate Instruction Manual - \\$12.00](#)

[WG K4500 Schematic - \\$2.00](#)

[1985 Heath Kit Catalog - \\$1.00](#)

[Electrohome G07-905 Schematic - \\$2.00](#)

[RGB-1401B Manual/Schematic - \\$12.00](#)

[Zenith RGB Monitor Schematic Set - \\$3.00](#)

[Lost Tomb Snd/Processor Blueprint - \\$1.00](#)

[K4902/03/52/53 Manual/Schematic - \\$3.00](#)

[TM202G Matsushita Man/Schematic - \\$5.00](#)

[Little Casino Manual - \\$10.00](#)

[Firepower Booklet - \\$5.00](#)

[Firepower Manual & Booklet - \\$10.00](#)

[Amplifone Manual/Schematic - \\$12.00](#)

[Williams Maintenance Manual - \\$10.00](#)

[Bally/Midway Standardized Manual - \\$10.00](#)

[Arachnid Parts Manual 6000 - \\$5.00](#)

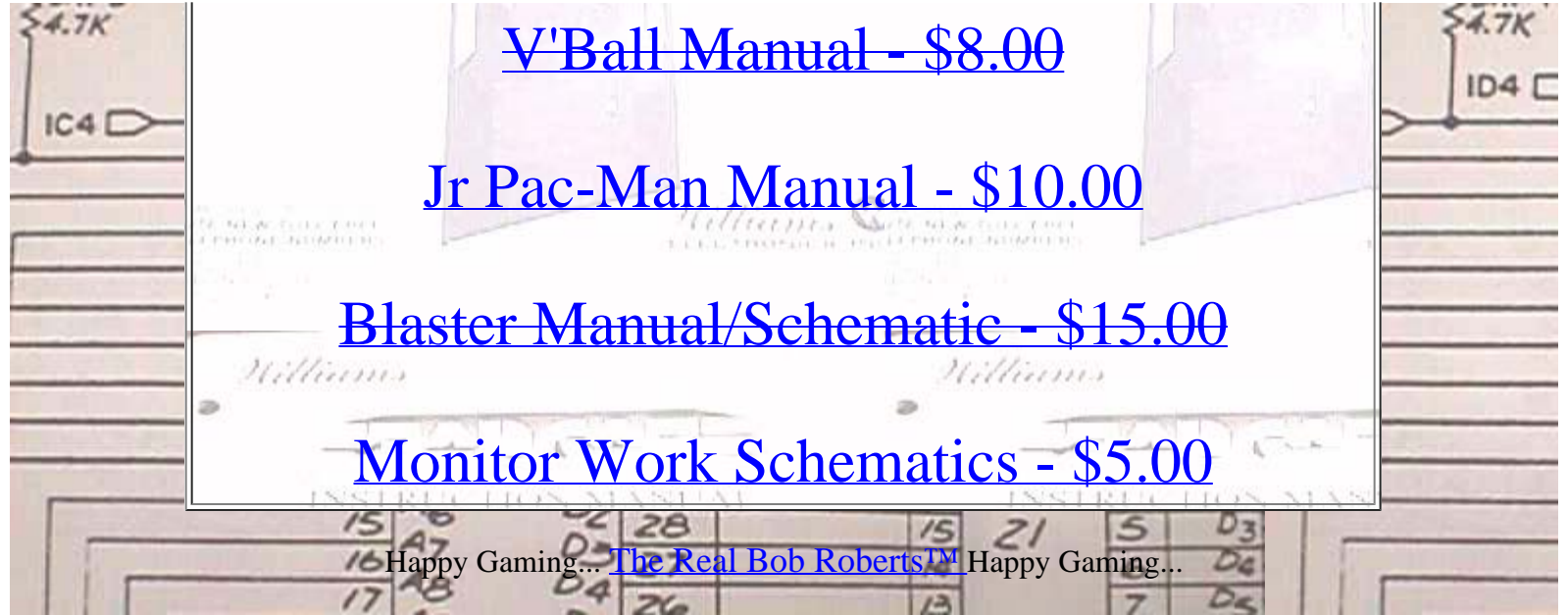
[Chexx Ice Hockey Manual/Scheme - \\$12.00](#)

[Arachnid Parts Manual 4500 - \\$5.00](#)

[Galaxian Manuals - \\$15.00](#)

[Quarterback Manual - \\$4.00](#)

[Pirahna Manual - \\$8.00](#)



[V'Ball Manual - \\$8.00](#)

[Jr Pac-Man Manual - \\$10.00](#)

[Blaster Manual/Schematic - \\$15.00](#)

[Monitor Work Schematics - \\$5.00](#)

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I get asked a lot why anyone would want these PCBs untested or missing parts if they don't know anything about repairing them & the answer is simple.... If you own the game or even have a working bd of the same title that you swap into a cab, many times just replacing one blown ROM from the parts bd will save you what you paid for the parts bd. Some custom parts may be well over a hundred dollars from the game mfr & having that spare may save your favorite game bd. Many an op's classic games were saved from conversion when they needed an expensive part that was not practical to buy from a distributor or game mfr & they had the parts bd in their warehouse. In fact, that is where a majority of these bds come from... the ops are using their parts bds as cash in this poor economy.

Updated 3/25/2016

Everything below on sale at, or below, scrap prices... as-is!

[Greyhound Board Bundle](#) - \$90.00

[Working Plotting](#) - \$25.00

[Sinistar Set](#) - \$30.00

[Pro Wrestling](#) - \$5.00

[WMs Rom Bd Def](#) - \$15.00

[WMs Rom Bd](#) - \$7.00

[Gottlieb CPU](#) - \$10.00

[Karate Champ](#) - \$5.00

[10 Yd Fight 2 of 3 Bds](#) - \$5.00

[Warp Warp \(Stored Working\)](#) - \$10.00

[Super Basketball Main](#) - \$5.00

[Moon Shuttle \(Stored Working\)](#) - \$10.00

[Frogger Main](#) - \$5.00

[Frogger](#) - \$7.00

[Quarterback](#) - \$5.00

[WMs 5770-12204](#) - \$5.00

[K4600 Reg Bd](#) - \$10.00

[Box of Five PCBs](#) - \$35.00

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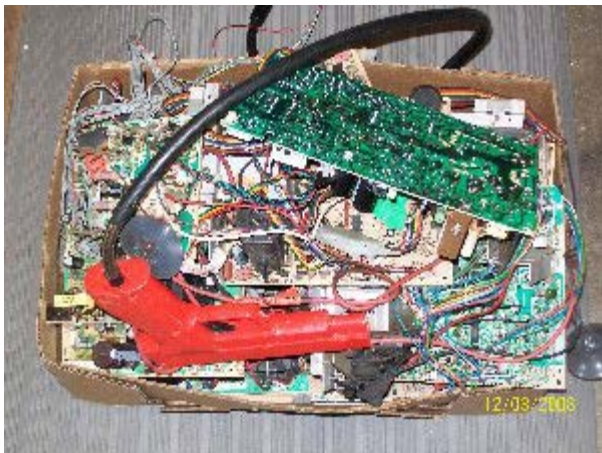
Mo Junk

Times are tight & getting tighter, so when one of the ops offered up a couple boxes of junk towards his bill I jumped at it. Like I need more junk here... Anyway, aside from the economic aspect of this junk is the fact that more & more of these parts are becoming obsolete & discontinued almost daily. There are a pile of WG monitor chassis' among this junk & most of them are priced at just what you'd have to pay for nearly any one of the parts that you may need. WG has discontinued most of the width coils and the price of what I could find left out there still available was \$12 & up, so a width coil may soon be worth having a spare parts chassis on hand. The ones that have remote boards are at the current price of just the used remote board alone affording you a backup width coil, regulator, HOT, diodes, obsolete standoff resistors that are frequently needed, neck bd, xsistors & a host of other parts to keep your chassis running at no extra cash layout.

Of course, for the newbies that need to practice their soldering skills before diving into their pride & joy monitor, game bd, whatever, and smoking it out of the gate, these will make excellent training exercise boards. Hmmm... come to think of it, after seeing some of y'all's soldering jobs in pics... maybe they'd work out well for you not so newbie guys that need a little refresher course :-)

Updated 3/25/2016

Now that the K4600, K4700, K4800, K4900, K5500, & K7000 width coils are obsolete & no longer available these parts chassis' are even more of a desirable thing to have on the back shelf for spare parts.



Seems all the monitor chassis junk is gone & this is just a conglomeration of odds 'n ends of junk now. I'll check with local ops to see if I can find y'all some more chassis' for spare parts.

[10-Yard Fight PCB Set - \\$10.00](#)

[Narc Sound Bd - \\$10.00](#)

[Stern VFB-1000 - \\$12.00](#)

[Top Speed PCB Set - \\$14.00](#)

[HV Shields - \\$1.00 ea](#)

[Large Heatsinks - \\$3.00 ea](#)

Happy Gaming... [The Real Bob Roberts™](#) Happy Gaming...

Bob's Bad Trader List

A few of you have asked to reprint this list on your sites to aid y'all with your trades & sales & I have declined in the past. Since things are getting a little out of hand with much larger orders going unpaid, jeopardizing the cross ship list, we hereby grant permission to reprint this page.

Edgar Shupe - Riverside, CA
Scott Griffith - Belle Chase, LA
James Reed - Stone Mountain, GA
Chris Mckeman - Panama City, FL
Jeremy Abel - Brooklyn, NY
Matthew Jackson - St Petersburg, FL
Ryan Olds - Manistee Paintball, MI
Mark Ignatowski - Brecksville, OH
Lucas Guilbeault - Bowmanville, Ont, Canada
Darrell Marcum - Trenton, OH
Larry Nash - Vidor, TX
Mike Morris - Waterford, CA
John Rucinski - Scotia, NY
Mark Lusche - Minden, NE
Raymond Leonard - Mesa, AZ
Ryan Sondergeld - Monroe, MI
Raquel Roddy - Streetboro, OH
Aaron Schofield - Tucson, AZ
TJ Roddy - Streetboro, OH
Greg Nugent - Fredericksburg, VA
Matt Keller - Gardnerville, NV
Joseph Fracasso - Elmhurst, IL

Mary Nilan - Lohnewulf - Blakeslee, PA

Brendan Schrader - Philadelphia, PA

Jesus Ramos

145 Big Black Dr

Kissimmee, FL 34759

JRamosAcevedo@GaylordHotels.com

juny32763@cfl.rr.com

Jorge Dominguez

24852 Acropolis Dr

Mission Viejo, CA 92691

Jdpitaco@aol.com

Save Time, Save NSF Fees, Save Certified Fees, Save Court Filing
Fees, Save Your Games/Parts, Save Yourself... Run, Run, Run
Away!!!

Mary Whalen/Nilan - Lohnewulf - Mount Bethel, PA

Scott Stilphen - Rock Hill, SC

Matt Moran - Salisbury, NY

Tom McCauley - Coldwater, MI

Mark Ormond - Chattanooga, TN

Ron Bennett - Danville, KY

James Chronister - Jacksonville, FL

Joseph Nilan Jr - Lohnewulf - Mount Bethel, PA

Anthony Clayton - Janesville, WI
Terry White - Tamaqua, PA
Mike Tinnes - Fargo, ND
Rick Trevino - Kennedale, TX
Bill Henke - Minneapolis, MN

PINBALL ODDS N ENDS

Updated 8/11/2013

Pinball Parts Package Deals	
Gottlieb Pyramid-type Lane Guide Package	\$40.00
NOS OEM	\$30.00
Standard Lane Guide Package	\$50.00
NOS OEM	\$40.00
97 Short Red Bumper Posts	\$40.00
NOS OEM	\$30.00
Odd Lot Of Pieces	\$20.00
NOS OEM	\$15.00
Wall Hangers	
Bally 1980 Parts Catalog	\$10.00

Manuals
Manuals Now Half Posted Price Below

All manuals \$15 unless otherwise noted.	
Bally	
Electronic Pinball Repair Procedures FO560	
Electronic Pinball Repair Procedures FO560-1	
Electronic Pinball Repair Procedures FO560-2	
Electronic Pinball Repair Procedures FO560-3	
Flash Gordon	
Freedom	
Future Spa	
Lost World	
Power Play	
Space Invaders	
Data East	
Checkpoint	
Game Plan	
Attila	
Foxy Lady	
Sharpshooter II	
Gottlieb	
Cleopatra	
Jacks to Open	

Mars
Pink Panther
Shaq Attaq
Volcano
Stern
Meteor
Williams
Millionaire
Tic Tac Strike
Work Copies Various Mfr \$7.50 Ea
Bally Beach Time
Bally Miss America
Bally Sea Island
Bally Sun Valley
Bally Venice
Williams Funhouse
Williams Riverboat Gambler

EM Schematics &/or Manuals

All \$20 unless otherwise noted.		
Manufacturer ?	Title	Year ?
Bally	ABC Bowling Lanes	?
Bally	All Star Bowler	?
Bally	Amigo	4/74
Bally	Balls-A-Poppin	7/56
Bally	Bus Stop	11/64
Bally	Carnival	7/57
Bally	Champion	4/49
Bally	Circus	8/57
Bally	Citation	9/48
Bally	Club Bowler	?
Bally	Deluxe Club Bowler	?
Bally	Deluxe Jumbo S.A.	?
Bally	El Toro	3/63
Bally	Golf Champ	?
Bally	Gunsmoke	?
Bally	Heavy Hitter	?
Bally	Jolly Roger	11/67
Bally	Jumbo	?
Bally	Kentucky	4/49

Bally	Lucky Alley	?
Bally	Monarch Bowler	?
Bally	Moon Raider	?
Bally	Night Rider	3/77
Bally	Official Jumbo	?
Bally	Pan American Bowler	5/41
Bally	Sharp Shooter	?
Bally	Sheba	2/65
Bally	Speed Bowler	?
Bally	Target	?
Bally	Twin Joker	5/73
Bally	USA	4/58
Bally	Whiz Bowler	?
Chicago Coin	Champion Rifle Range	?
Chicago Coin	Criss Cross Bowler	?
Chicago Coin	De Ville Bowler	?
Chicago Coin	Festival	8/66
Chicago Coin	Fire Cracker	8/63
Chicago Coin	Royal Crown Bowler	?
Chicago Coin	Spotlite Bowler	?
Chicago Coin	Triple Gold Pin Bowler	?
Chicago Coin	Triumph Bowler	?
Crown	Basketball 902	?
Evans	Galloping Dominoes	?
Evans	One Rol-Hi	?
Gottlieb	Aloha	10/61
Gottlieb	Corral	8/61
Gottlieb	Dancing Dolls	4/60
Gottlieb	Egg Head	11/61
Gottlieb	Gaucha	11/62
Gottlieb	Grid Iron	11/77
Gottlieb	Happy Clown	10/64
Gottlieb	Hot Shot	8/73
Gottlieb	Jungle	6/72
Gottlieb	Olympics	8/62
Gottlieb	Paradise	9/65
Gottlieb	Sin Wheel	12/67
Gottlieb	Super Score	1/67
Gottlieb	Super Soccer	12/74
Gottlieb	World Fair	2/63

Keeney	Big Tent	?
Keeney	Pop Corn Vendor 200	?
Midway	Cobra S.A.	?
Midway	Flying Turns	9/64
Midway	Little League	2/66
Midway	Rifle Range	6/63
Seeburg	Multi-Rayolite Rifle Range \$50.00	10/39
United	Astro S.A.	5/63
United	Avalon S.A.	4/62
United	Bank Pool	11/63
United	Batting Practice	?
United	Caravelle S.A.	2/63
United	Classic B.A.	6/61
United	Deluxe B.A.	7/57
United	Line Up	12/60
United	Mark-VI Bank Pool	?
United	Polaris B.A.	7/64
United	Regal B.A.	4/63
United	Sure Fire S.A.	9/60
United	Rumpus Shuffle Targette	?
United	Thunder Bowling Alley	?
United	Tiger S.A.	3/63
United	Ten Strike	?
United	Topper S.A.	1/64
United	Two-In-One	7/64
United	Ultra Shuffle Alley	8/63
Williams	8-Ball	8/65
Williams	A-Go-Go	4/66
Williams	Base Hit	2/67
Williams	Beat Time	8/67
Williams	Big Chief	8/65
Williams	Big League Baseball	3/65
Williams	Double Play	8/65
Williams	Jolly Roger	11/67
Williams	Hot Line	8/66
Williams	Merry Widow G#291	7/63
Williams	Oh Boy	6/63
Williams	OXO	11/73
Williams	Soccer G#292	2/64
Williams	Student Prince	5/68

Williams

Tom-Tom G#272

12/62

Looking for transistors, rams, eproms, darlingtons, diodes and other semiconductors used in pinball machines? Try [HERE](#).

[Rewind](#)

[The Real Bob Roberts™ Site Index](#)



Sal Says, "This # % @ * Has Got To Go!!"

Well... my brother-in-law Sal has come to give us a hand around here & it hadn't even been a week yet before I had to clone him :-). Yup! Not twins... a clone! He wants to clean up all the back buildings & the warehouse, but he says I got too much crap (:not exactly the word he used :) laying around all over the place! He just came in & ask me if I knew I had a new lawn mower way back in a corner under a bunch of junk in the carpentry shop... hmmm? I said no at first, but then I remembered that shortly after the storm, when our street was still unpopulated & the lawns had become rat infested fields (those that could swim), I was first in line at the Home Depot yard sale. Snagged a chain saw for the many cords of wood in my yard & a lawn mower... which I used to mow every lawn on this street with. Still had gasoline leftover, so I pressure washed the street & sidewalks during the next few days. When the returnees began showing up they were amazed with our clean street & trimmed lawns. One neighbor was so appreciative that he gave us a couple of huge steaks he had brought back from Texas. Real food after all those MREs... ah but I ramble..... let me get to listing the crap Sal wants gone from here before he asks me, "what's this", again.

Updated 5/17/2015

All Sales Final - No Warranties - As-is - Caveat Emptor

This page is comprised of 100% junk!!!

<i>A lot of this junk is stuff that ops traded in towards their service bills, stuff I had leftover from building gaming machines and just general junk that was accumulated over the many years that I was in business. Some of it new, although having been stored for so many years it may not look like it. Other new salvage stuff that I bought for the parts that I was able to use... such as project boxes for homemade test equipment & a lot of other odds & ends.</i>	
Ms Pac PCB Package	\$??
Juke Wall Box 2 left	\$20.00 Ea
Used Leafswitch Blade Adjuster	\$4.00
Over/Under Skin	\$4.00
Gottlieb Coin Door	\$7.00

Back Of Coin Door	\$0.00
20EZ Neck Board Protector	\$1.00
Electronic Coin Mech	\$3.00
Gottlieb Coin Door	\$7.00
Back Of Coin Door	\$0.00
Single Coin Mech	\$1.00
AMI Wall Box	\$25.00
O/U Coin Door Frame	\$2.00
Service Switch	\$1.00
Bally Coin Door	\$7.00
Back Of Coin Door	\$0.00
Crimper Bench Jig	\$30.00
Monitor Parts	\$2.00
Neck Board	\$2.00
Project Box +	\$1.00 Ea
Lamp Holder	\$1.00
Midway Coin Door	\$10.00
Back of Coin Door	\$0.00
Gas Pedal Assembly	\$5.00
Control Panel Latches	\$2.00
Ms Pac Monitor Brace	\$2.00
Ms Pac Coin Bucket Holder	\$4.00
Jukebox Coin Door	\$5.00

Sal has a gazillion pics of junk & I'll add more here whenever I can spare a few minutes.

[Parts Page](#)

[Site Index](#)



I'll put something different here every once in awhile so keep checking :)

Updated 2/9/2016

All Sales Final - No Warranties - So Ask Before You Buy

Clearance Packages

One of a Kinds

Used Test Equipment:

Used Parts - Hodgepodge

[Recently Purchased Short E-clip Buttons \\$1.00 Each](#)

- [K3000 Parts Chassis - \\$15.00](#)
- [Box of Five PCBs - \\$35.00](#)
- [6' PC AC Cords - \\$2.00](#)
- [18" PC AC Extension - \\$1.00](#)
- [6' PC AC Extension - \\$2.00](#)
- [Multi-value Can Cap - \\$7.00](#)
- [32 Assorted Transistors - ~~\\$20.00~~ \\$15.00](#)
- [WG Remote Bd P832 \(3 left\) - \\$15.00](#)
- [OEM Hantarex Resistors - \\$6.00ea](#)
- [OEM Hantarex Trimmer Pots - \\$5.00ea](#)
- [A Few Slot Machine Pieces - \\$5.00](#)
- [25 Nickel Plated Smooth Head 1/2"x10-24 Bolts/Nuts - \\$2.50](#)
- [1 1/2" Bolts W T-nuts - \\$2.00](#)
- [1 Bag Misc Security Hardware Pieces - \\$2.00](#)
- [1 Bag Drawer Pulls w Hardware - \\$3.00](#)
- [Pack of 4 Snap Fasteners - \\$2.00](#)
- [1 Bag Misc Switches - \\$3.00](#)
- [Fuse Holder - \\$1.00](#)
- [5VDC Pilot Lamp - \\$1.00](#)
- [Promax/Eygo Remote Board/Cable - \\$25.00](#)
- [K1-2 -VO Remote Board/Cable - \\$25.00](#)
- [AP-0621P Remote Board - \\$20.00](#)
- [MTC-9000 Neck Bd Cover - \\$2.00](#)
- [Coin Doubler Bd - \\$15.00](#)
- [Just 4 Kits Left - \\$30 Takes them All](#)
- [3 Crane Claw Boards - ~~\\$50.00~~ \\$15.00](#)
- [Coin Window Pairs from - \\$5.00](#)
- [Bally Bingo 25¢ Entry Plate NOS - \\$5.00](#)
- [Coin Door For Parts - \\$10.00](#)
- [Stern Power Supply 1100 or 1200 - \\$10.00](#)
- [WMs Romless Bd - \\$10.00](#)
- [Pole Position Mon/Marquee Trim - \\$10.00](#)
- [Hasp Sets - \\$2](#)
- [Padlock w 2 keys- \\$4](#)

- [100' Reel 5 Conductor Cable - \\$20](#)
- [12 Volt Alarm Siren - \\$8.00](#)

Happy Gaming.....

[Back To Parts Page](#)

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This is just a hodge podge of chips from various work stations, caddies & hard libraries. Some are new, some used & others that were programmed for hard storage & unused. Some, like the NBA & Street Fighter chips, were just replaced with OEM burned program update chips. These are all going to be \$5 per chip unless otherwise stated... such as the set of Williams rams. I have tons of these & will add to the list as time permits. Also, to save time I will test them as they are ordered to be sure they are still operable. Hopefully, the \$5 will cover my time in setting up, testing them and adding them to this HTML. Even though I will make sure that these are 100% functioning before shipping any, they will still be sold as-is with no warranties. Take caution when placing chips in sockets that they are properly orientated & that all legs are in the socket & not hanging over at one end or the other or they will be smoked into uselessness upon powering up :-(Some chips are factory labeled while others are hand written labels.

Updated 9/6/10

Various New & Used Roms & Chips
NBA Jam OTPs
UG14 5341-13401-00
UG16 5341-13401-01
UG17 5341-13401-02
UG18 5341-13401-03
UJ14 5341-13401-04
UJ16 5341-13401-05
UJ17 5341-13401-06
UJ18 5341-13401-07
UG19 5341-13401-08
UG20 5341-13401-09
UG22 5341-13401-10
UG23 5341-13401-11
UJ19 5341-13401-12
UJ20 5341-13401-13
UJ22 5341-13401-14
UJ23 5341-13401-15
UG17 L1

UJ17 L1
UG18 L1
UJ18 L1
UG12 L3
UJ12 L3
U3 SND 5341-13401-15
U12 SND 5341-13401-16
U13 SND 5341-13401-17
U3 SND L2
U12 SND L2
U13 SND L2
TPC1020AFN 5410-13520-00 Rev 1.5
TMS34010FNL
Street Fighter Series
12 Sets of 3 Like This One Available - \$15 Per Set
U21/22/23 SF2T Set of 3 - \$15
U21/22/23 S92 Set of 3 No Pal - \$15
U22/23 Singles At \$5 Each
OEM OTPs I Have Multiples Of Most
0072-M932A-39SO9332B-2 Midway 1981
0072-M932B-39SO9332B-2 Midway 1981
0072-M932C-39SO9332B-2 Midway 1981
0072-M932D-39SO9332B-2 Midway 1981
0072-M932E-39SO9332B-2 Midway 1981
0072-M932F-39SO9332B-2 Midway 1981
9316A E720-20-U6
9316A E720-30-U6
9316A E720-35-U6
9316A E720-53-U6
9316A E776-10-U1 Nitro
9316A E743-14-U1 PB
9316A E743-12-U2 PB
9316A E786-16-U1 SBM
9316A E786-17-U2 SBM
9316A E721-12-U1 NR
9316A E721-13-U2 NR
9316A E722-17-U2 EK
9316A E725-21-U2 MH
9316A E792-07-U4 SI
9316A Hot Hand U2

7641 652/1X
7641 652/2X
7641 653/1
7641 653/2
7641 654/1
7641 654/2
Defender Rom 3
WMs Video Decoder Rom 2
WMs Video Decoder Rom 3
WMs Video Decoder Rom 6
Gorgar Sound Rom 1
Gorgar Sound Rom 2
035127-02
035143-02
035144-02
M739G thru F Space Invaders Set - \$20
Flipper Rom 1
Flipper Rom 2
Programmed Eproms
2716 Rom 5 Black Knight
2716 U2 S&T 8 Ball Deluxe
2532 U2 & U6 Set 8 Ball Deluxe - \$10
2532 U2 & U6 Set Black Pyramid - \$10
2532 U2 & U6 Set X's & O's - \$10
2532 U6 Skate Ball
2532 U2 & U6 Set Ted Nugent - \$10
2716 U2 Strikes & Spares
2532 U2 Nitro Ground Shaker
2716 U2 Black Jack
2716 U1, U2, U5 & U6 Set Ali - \$20
2716 U2 Dolly Parton
2716 U2 Night Rider
2532 Ms Pac U6
2532 Ms Pac U7
2532 Pac/Ms Pac M932A
2532 Pac/Ms Pac M932B
2532 Pac/Ms Pac M932C
2532 Pac/Ms Pac M932D
2532 Pac-Man M932E
2532 Pac-Man M932F

2532 Ms Pac M932E
2532 Ms Pac M932F
2532 Stargate 3A
2532 Stargate 12A
2716 WMs Sound Rom 1
2716 WMs Sound Rom 2
2532 WMs Defender Rom 2
2532 WMs Defender Rom 3
2764 MDS-SM4 1A or 6A
2764 MDS-SM4 1B or 6B
2764 MDS-SM4 1C or 6C
2764 MDS-SM4 1D or 6D
2764 MDS-SM4 2A or 8A
2764 MDS-SM4 2B or 8B
27256 Taito Wardner 20
2764 MDS-SM4 1B or 6B
5410-13520-00 Rev 1.5

This is going to take longer than I thought.... I'll be back :-)

Price Increases

Between mfr's price increases & shipping increases here lately it's a full time job just keeping up with them. Alice brings up something new that we are selling at a loss at least once a week & sometimes several times during the course of a week. Many items are pricing themselves out of our lineup. Happ has been going up on items at a steady pace since their merger... maybe price hikes to them are behind this, but for whatever reason it was one of the reasons for our recent decision to drop Happ products.

Anyway, here are a few things that recently increased that we had to go up on or are in the process of going up on as soon as our older stock runs out. Most items listed as "sold out" on the Parts Page will not be reordered.

Isolation Transformers:

These have pretty much doubled in price. Shipping them has had a small part in this, but it has always played a part due to their weight. The main reason is that mfrs are discontinuing them on the skirrtails of CRT monitors being discontinued.

Cam Locks:

Price increases in shipping, materials & even keys have caused this latest shipment to double in price... but wait... we discussed this with the mfr & worked out a deal for parts less keys & cams whereby we could assemble them here for you using hoarded keys & cams from the past. We'll still have to go up, but at an affordable increase.

AC Line Cords:

Shipping... weighty, copper & labor prices have caused these to continue to climb in price. Nothing we can do to offset it :-(Well... I did search surplus stores for the 8 footers & even found a couple batches of them, but the shipping quotes they gave me put them over the top... one at nearly \$600 & when I questioned it they verified it & explained that was shipping & handling. I thought that couldn't be from a neighboring state, so I went to the UPS online calc & it did price out at \$75 per case putting it right around their estimate. I thought about hiring someone with a pick up truck to go fetch them, but I forgot how much gasoline is these days :-(

The Mystery of Ordering FAQ

1/24/15

Handling a couple hundred emails a day with 13 to 15 being add-ons or changes to previous orders has resulted in many errors & proven to be too much for us old folks to handle. In the future we will not accept any changes to your original order once placed. Double checking on your end is much easier than us trying to change a dozen orders in the middle of a pull & wrap session each day.

2014... We are no longer shipping overseas.

Updated 9/1/3

How do I order?

All orders are via email only. Most just copy & paste the items they want into an email to [me](#). It is easier for both of us if you put the quantity first & paste the item after it, insuring that you receive the correct quantity.

There is no address on this site. The address will be in the email reply. Do not send any payments without a confirmed email order. They will be returned. No changes in the order via snail mail will be accepted. If you include your zip code or country in your email request your shipping quote will be more accurate. Furthest points are used as default without a zip.

Why only through email?

About 50% of stock is obsolete and when it is gone it is *gone*! Many things are one of a kind and without pulling & binning them, they may be sold to more than one person....as so often happens with dealers these days. Bins are also weighed for shipping calculations using the USPS online calculator.

What method of shipping do you use?

After being in business for 40 years and being on the receiving end of mutilations that were once packages of good merchandise, I chose to ship via the US Postal System which has done an excellent job for 4 years straight now. Everything is geared to ship USA Priority shipping and out of country is either Airmail Letter Post which is uninsurable and at your risk, or via Airmail Parcel Post Insured, usually double the price of ALP.

What forms of payment do you accept?

In the USA your check, bank check, money order are all acceptable, and your order is shipped the day that payment is received. International orders require a bank draft or money order in US funds and are also shipped out the day that payment is received. WU wire transfers to local pick-up points are **not** accepted.

This has been missed twice now, so I'll repeat it... Western Union wire transfers to local pick-up points are not accepted. You can send a WU money order directly to my address, but not to local grocery stores :-(

8/18/05 Missed For A Third Time - WU TRANSFERS ARE NOT ACCEPTED



Western Union Money Orders as pic'd above... that you buy & include with your snail mail are the only WU methods acceptable.

What's a bank draft?

A bank draft is nothing more than a check you purchase from your bank that is usually drawn on a US bank account. The fee they charge for this is generally much less than an international money order, yet it is virtually the same as a money order.

What's your phone number?

My phone is hooked up to a muted TAD most of the time as I don't have the time to answer all the calls coming in & be on the keyboard at the same time. Consequently, I don't take phone orders. My address is not on the Parts Page because I already get orders I cannot fill from people who have gotten my address from friends who have ordered previously, and have ordered something that has sold out, or have an order that weighs 16 lbs that they enclosed \$6 shipping for it to be sent to Ontario, Canada. Every so often I will be flooded by such orders after someone thinking they are doing good, posts my address in one of the newsgroups & I do what I can & send back the money to those I can't help.

There are so many hobbyist now that nither Alice, nor I, have the time to try to resolve these unconfirmed orders & they are now returned to sender if no matching email order exists.

Do you require a minimum order?

No. You can buy a single 50¢ item if you want, however the minimum shipping charge is still \$6.00 USA & \$7.50 international. Many of the outgoing packages cost more than the \$6/1 lb price, or the rate obtained from the online postal calculator, as the bin used for weighing is accurate for approximately 80% of all orders, but there are those that require a little more TLC when actually packaged & exceed the shipping price quoted. I pay the difference in those cases which have been as high as \$50 on a shipment of control panels to the UK.

- **Update May 2007:**

Due to all the USPS price hikes, the rising cost of gas, rising labor costs, incoming shipping rate increases, tax hikes, increases in packaging & packaging material we've come the conclusion that we have no choice but to raise minimum shipping prices. We are sticking with USPS Priority shipping on domestic orders due to their flawless record & quickness of delivery.

Minimum Shipping Rate To 1LB	\$7.00
Over 1LB Online Calculator	?????
Flat Rate Box No Insurance	\$10.00
Flat Rate Box Insured \$1.00-\$200	\$12.00
Flat Rate Box Insured \$201- \$300	\$14.00

Flat Rate Box Insured \$301- \$400	\$15.00
Flat Rate Box Insured \$401- \$500	\$16.00
Minimum Rate Canada & Mexico	\$7.00
Minimum International Rate All Others	\$10.00

- **Update May 2008:**

Well... as most of you already know, the post office has decided that they need new ponies once again and raised prices accordingly.... it looks like to get thoroughbreds this time! We had over 100 packages shipped this week that were over quoted shipping costs :-(Alice & I have talked this over & have decided that we will hold the line as long as possible even though it will cost from 45 cents to one dollar over the 2007 prices per package. We are hoping that the few products that have a profit added to them & the packages that are under the minimum shipping will average out to prevent us from going into the red.

USA

Large Flat Rate Box No Insurance	\$14.00
Large Flat Rate Box Insured \$100-\$200	\$16.00
Large Flat Rate Box Insured \$201- \$300	\$18.00
Large Flat Rate Box Insured \$301- \$400	\$19.00
Large Flat Rate Box Insured \$401- \$500	\$20.00

Canada & Mexico Max 20 LBS

Large Flat Rate Box No Insurance	\$30.00
Large Flat Rate Box Insured \$100-\$200	\$33.00
Large Flat Rate Box Insured \$201- \$300	\$35.00
Large Flat Rate Box Insured \$301- \$400	\$37.00
Large Flat Rate Box Insured \$401- \$500	\$38.00

You charged me \$9.00 shipping & it's on the package at \$8.00?

Pertains to above Q & to further explain, not only is there sometimes weight differences in the PO scales & my postage scales, but depending on how fragile an item is, it may require more packing material adding to the weight. Next is that the online calculator is not always accurate. *Big surprise*! Then the rates come into play with a difference of 1 ounce making a rate difference on the total package off by as much as three or four dollars either way... plus or minus... on heavier packages, and when it's questionable - borderline, I go with the next step up in cost & after 2 years of red ink for shipping costs, it is finally a break even venture. You may pay a dollar or two more on one package, but you'll also get those packages that actually cost four dollars more to ship than you paid. I must say that I do get many emails from around the world from collectors telling me that they noticed that it cost me much more to ship a package than they were quoted & offer to send the additional costs. Of course, I've never accepted their offers, but I do appreciate the fact that there seem to be an equal amount of people that take notice when they are seemingly undercharged.

Does Louisiana charge more for USPS Priority than the other 49 states?

I always get a kick out of this email in it's various forms & here's my story...and I'm sticking to it! I charge a pre-quoted shipping & handling fee which includes the actual postage, no matter the method used to ship, and although this is most often exactly the cost of shipping alone, if you need to feel better about this charge (I know I always do, especially when I receive a small package that I can throw half-way across a football field and I'm charged \$25 shipping :() then think about the other in-the-background expenses involved in shipping, e.g., packaging materials such as boxes at up to \$3 new or 50¢ used for any size not supplied by USPS, anti-static wrapping materials, bubble wrap, peanuts or popcorn, tape, invoice paper & label inks, USPS forms to be filled out and many other covert expenses. Office Depot has a direct line attached to my wallet... well, bank, actually.

The retort:

"You're suppose to pay that out of your profit!"

Huh? You'd better go back & check my prices as my bookkeeper/wife is telling me she is depressed at working with a red ink pen only :(....:)

Do you ship C.O.D.?

No. Mostly because of the extra time constraints due to the additional paperwork & bookkeeping, but there are many other reasons including the dreaded email...* I won the widget in an online auction for less money, or I went to my first arcade game auction on Saturday & won the widget for the same price, but I'll save the shipping fees *...well, unfortunately Uncle Sam doesn't return that COD package to me along with a shipping & COD fee refund, so I still have to pay more than you essentially saved.

Do you accept credit cards?

No. Actually, I stopped taking them before I retired at a point when the fees were outrageous IMHO. To break even my guess is that I would need to raise prices by 7.5% across the board, which I do not want to do, and there would also be the dreaded additional book work. Even though I thought it illegal, I know that some companies just charge you the additional fee for using a credit card over the cash/check price, but I simply do not have the time to be working for a credit card company & would rather apply the time to aiding you in your endeavors, while saving you money at the same time.

Do you use PayPal?

Absolutely not! I would have to factor in a 10% increase in prices by my guess, in order to accept payment this way. They charge a fee for their services & an additional fee for sweeping the account, and, unlike a direct credit card deposit, I would need a blind sweep account at my bank making this an expensive proposition for you & me, alike. For individual collectors trading & handling auction items, I would assume that PayPal is fine, although there are many other online companies that provide a service similar to theirs. In my limited experience, I prefer a company such as [BidPay](#) where you know from the start how much extra you'll pay and the service is extremely fast & secure. Unfortunately, they only handle auction merchandise at the current time.

Many people have been using this service for the past couple years... [PayingFast](#) and the only feedback I have gotten is that they request a fax of your driver's license & CC, which to me sounds like a good idea... protecting your interests.

Update March 2007... WOW! The eleventh year is going by fast!

A few European hobbyist have had good experiences with this new service:

[Auctionchex.com](#)

Eddie was very prompt in emails when one payment took a little longer than it should have, and, he stuck with it to the payment arrived here.

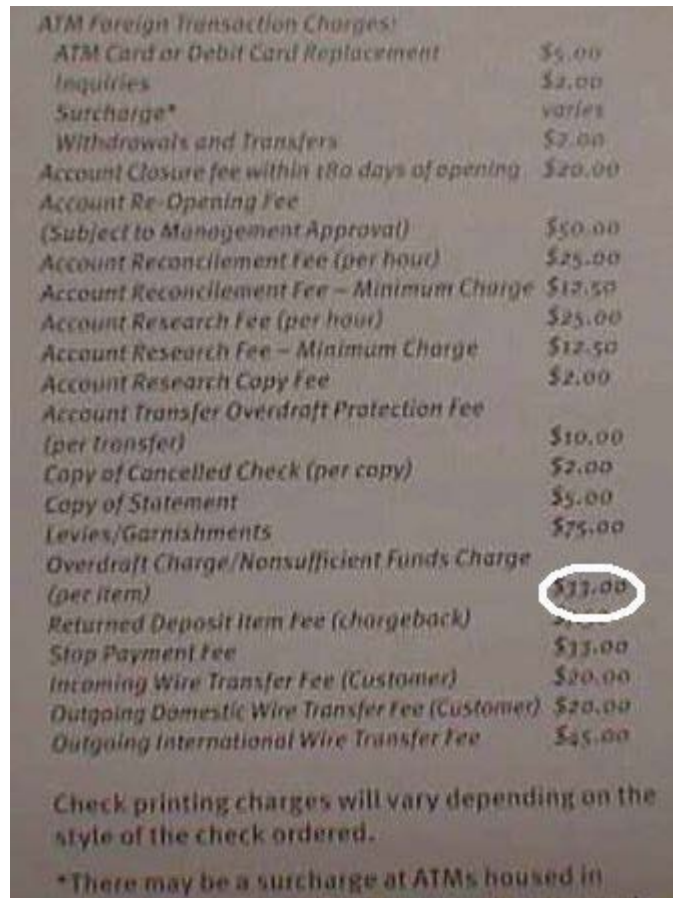
Do you do bank wire transfers?

No. I opted for a new way of banking which has some sacrifices, but the advantages far outweigh them. After twenty years with my previous bank.... which had changed hands so many times that I was never quite sure what the current name was... they returned a NSF check to me & charged me \$20, which I thought surely had to be a mistake since last I knew it would have only cost me \$20 if I had bounced the check! Nope... not the case. When I phoned them and was read the current fees for different items, I went bank shopping. In this particular case, the endorser told me the problem was straightened out & to go ahead & redeposit the instrument. Yes... it came back again! I started thinking that here is \$40 out of my pocket so far, and most likely \$40 out of the endorser's pocket and this check is for \$15... has the banking community gone overboard, or what...\$95 for \$15 worth of parts! The best I could do for you on my end... not that I want an NSF check, but I do know that sometimes a situation beyond your control may cause one....was an account that would try to make the instrument good twice before putting it on microfiche, I presume, and shredding it, all for \$3.00. The catch is if I want a copy of it, I have to buy it! The upside is that you only need to pay \$3 more on my end..... your bank is probably going to still catch you for another \$20, but I can't help on that end.

My bank has doubled it's fee this year to \$6 per incident:-)

Looks like my bank was the last of the local banks to be swallowed up by the big national corps :-(Beginning the 1st of August 2006 the NSF fee is jumping to \$25 :-(No one can afford to accidentally bounce a check any longer... well, I know I can't as my fee has gone to \$35 if I bounce one myself :-(And I was just complaining about the \$30 fees accumulated during Katrina down time.

Update of bank fees as of 1/1/2012. Looks like my bank knocked off a couple bucks if I bounce a check, but the bad news is that they evened it out by bumping up the NSF charge to \$33.00, as well! My scanner died, but I was able to take a pic of their charges & they have a charge for every imaginable situation.



<i>ATM Foreign Transaction Charges:</i>	
ATM Card or Debit Card Replacement	\$5.00
Inquiries	\$2.00
Surcharge*	varies
Withdrawals and Transfers	\$2.00
Account Closure fee within 180 days of opening	\$20.00
Account Re-Opening Fee (Subject to Management Approval)	\$50.00
Account Reconciliation Fee (per hour)	\$25.00
Account Reconciliation Fee - Minimum Charge	\$12.50
Account Research Fee (per hour)	\$25.00
Account Research Fee - Minimum Charge	\$12.50
Account Research Copy Fee	\$2.00
Account Transfer Overdraft Protection Fee (per transfer)	\$10.00
Copy of Cancelled Check (per copy)	\$2.00
Copy of Statement	\$5.00
Levies/Garnishments	\$75.00
Overdraft Charge / Nonsufficient Funds Charge (per item)	\$33.00
Returned Deposit Item Fee (chargeback)	\$33.00
Stop Payment Fee	\$33.00
Incoming Wire Transfer Fee (Customer)	\$20.00
Outgoing Domestic Wire Transfer Fee (Customer)	\$20.00
Outgoing International Wire Transfer Fee	\$45.00
Check printing charges will vary depending on the style of the check ordered.	
*There may be a surcharge at ATMs housed in	

Will you ship my order & send me a bill?

No. This Q seems to be born out of the cross shipping list I have. Whenever possible I do cross ship orders, meaning that I will ship the order as soon as you have sent the payment, however, this is for established customers that place orders on a regular basis and providing I have the time & resources to cover the shipping. In the past, some have used this as though it were an open account here, which I cannot do because it does tie up so much working capital, which is precisely what happened... ran out of funds to reorder merchandise or ship current orders... at which time my wife took the reins from me & runs the cross shipping with a calculated abandonment of emotions & has set rules that if the payment is not received 10 days after it was supposedly sent, your name is removed from the cross shipping list :(

Will you ship my order with no insurance?

Believe me, I know why you want it uninsured in the US. The USPS postal carrier will not leave a package that is insured for \$51 or more at your residence if there is no one there to sign for it... yes, even if that mailman is your relative, he's NOT going to leave it! He's suppose to leave you a notice of attempted delivery, however, this is seldom done and your package is sitting at the post office waiting for you contact them to schedule another delivery, or to make arrangements to pick it up. If you do not do so, they send it back to me after a few weeks.

Yes... I will ship uninsured on a per order basis at your risk. Be advised that you are risking the amount of the total order

in case of loss or damage. This is applicable to cross shipped orders, as well. It is one thing to say ship it uninsured and I will be responsible if anything happens, and quite another if you receive a \$150 package that was thrown under a moving mail van's tire to stop it from rolling down the hill. Remember, no one wants to pay for a dead horse except the mucilage manufacturer :(

When will you ship my order?

If you confirm your order with a mailing address in email, I will package & label the order to go out on the day of receipt of payment with no waiting. Without a shipping address the order will ship on the following day as mail is delivered late in the day leaving barely enough time to round up packages & get them to the post office. NOTE: Any changes in your order have to be done in email prior to shipment for this same reason. A change made in the snail mail may not be read until you have the package already.

Will you notify me upon receipt of payment?

Yes. You will be notified on the day of payment receipt & order shipment with an expected time of arrival at your locale. The only exception is that Saturday's receipts are held over till Monday since the post office is closed when I receive the mail, so all it would gain you would be 2 more days of anxiety :(

It's been a week and I still have no package...what happen?

Chances are that your package is not lost. Invariably this package is at your local post office. It has been taken back because it was insured for \$51 or more, and often times at the discretion of your postal carrier, a package that is not even insured at all, will be taken back to the post office if he feels that it wouldn't be prudent to leave it.

Occasionally, a Priority package will take 7 to 8 days to arrive and I can only surmise that somewhere along the line, someone decided to take a peek inside :(There never seems to be any damage or mislabeling, just a pure breakdown in the postal service for some reason beyond my comprehension. Of course, this always happens with components that are desperately needed for the weekend's projects & never with a part you bought to have as a spare :(

Out of country orders that are late invariably turn up at customs, rather than the post office. The reason for this is that the customs label sometimes comes off during transit (I don't put them on, or they would stay!) and they then open & go through your package to make sure it doesn't contain any contraband... like no one lies about it on a label, duh...and for some reason they enjoy opening the packages, but do not like to reseal & send them on there way. At least 100 packages in the past 4 years , or so, have been found at customs in a dozen countries, some of which I am embarrassed to say I never heard of, but the no repackage policy seems to thread them all together :(

What to heck is lagniappe?

Lagniappe is a custom practiced here in Louisiana & I'll give you Webster's definition.....

"lagniappe or lagnappe n. 1. a small gift given by a merchant to a customer for making a purchase. 2. a gratuity; tip"

Whenever possible, something is randomly thrown in with your order that my wife or I think you may be able to use, or the brownie cookies or trinkets at Mardi Gras time, or sometimes even the shipping container such as the Rubbermaid containers that were used to ship buttons & joysticks several times. You never know what, or when, you'll find some oddball item in your order... calculators... telephones... tool sets... toys... extras of the same part... vid game posters... flyers... boxes of lamps or stuffed animals just to name a few of the items already sent out as lagniappe.

What sort of warranty do I get?

There is no warranty implied or expressed. Some of these parts were made as far back as 1938 & are obsolete now. Game boards? Yeah... remember I'm the guy that sees pics everyday that you send asking me why your board that you bought/traded from another collector doesn't work, and I see chips in the wrong places, I've even seen IC pins hanging out of the sockets in a PIC where you've accidentally installed it improperly, I couldn't even guess at how many have sent me pics with interconnect cables going to the wrong places or upside down on the connector, and the smoked roms from backward installations... jeez... I could write a book about these instances & have the pics to go with it :) Electronic

parts? Well, I read the 1 page document at the local electronic parts wholesaler, and it basically says that once it leaves the store it belongs to you. I just read a couple from catalogs here and they say about the same thing in legalese such as: Since we do not control the mfg of the product yada yada yada..... Since the seller cannot control the manner or use of it's products after the sale the seller is not responsible for any replacement of said product or damage caused by said product consequentially or indirectly, and yada yada yada.

All I can tell you is that I will test anything that is possible before shipping & tell you the state it is in when it leaves here. You can ask about any part's condition before buying. Some people are leary about all sales final to a point where they ask if the microswitch pushbuttons are new in a first email, and in a subsequent email will ask if the Cherry switch comes with it, and some even ask in a third email if they are copies or the real ones :), but I guess with as many unscrupulous dealers as I've seen online, I'd be a little leary myself. BTW: They are new with switches & the real McCoy :)

What sort of price can you give us for 5000 of the xxx ICs?

For the most part, prices are at 100 lot or better per item and I am not a chip broker or general wholesaler. On scarce items, I may only have a few of them.

Isn't this your business, selling parts?

Not really... sort of...well, I came to RGVAC/M to sell off parts left from my business as I had plans to retire in September of 2000 with the remainder of the parts to be bulked off at that time. Well... I made a lot of friends in the video arcade community here & in the UK, Canada... jeez.. all over the world, and was repeatedly asked to stay on & offer advice & parts after retiring. Well I caved, and when I finally retired from the coin-op industry on August 18th of 2000, I enlisted my wife to help maintain this little mom-and-pop operation to serve the video arcade game collecting community. Little did I know that this was still going to take the same 140 hours per week that I spent between this & my business. It simply freed up the hours I needed for my business & expanded the hours I had available for the arcade game collecting community. This might also be because of new recent friends into MAME who need advice (sometimes way over my head, since this is a far different field than coin-op) and common parts for their projects. I'd be remiss if I didn't mention my friends at RGP and of course, my jukebox collecting friends whose group is a little harder to find :)

Shipping Clarification

2014... We are no longer shipping overseas.

Back in the 90's when Alice & I were selling off, giving away, our inventories at fire sale prices prior to retirement we were contacted by several collectors from the UK's RGVAC equivalent requesting we ship overseas. After a few months we got a forwarded email from many of the members at that time asking us to please consider shipping overseas as it was hard to get any supplier to ship to them, so we talked it over and decided to do so as long as it was not at our risk.... buyer assumes all risks as laid out in the ordering FAQ. It seems today everyone ships overseas, so it shouldn't be a problem for anyone needing parts.

Fast forward to today with August 2010 upon us, in our 15th year of helping hobbyist smoothly & we've hit our first dissatisfied buyer. At this point his package is only late in arriving, but he raises so many points to his dissatisfaction that I thought I should make replies here, so as to prevent any other hobbyist from erring in ordering from us. Most of the things are way beyond our control, anyway, but I'll relay the USPS views & rules as told to me over their 800 number by a supervisor within the past hour.

The Order!

1 Midway OEM PS (90400) Cap Kit - \$15.00
First-Class Mail® International Uninsurable At Your Risk - \$10.xx
Total - \$25.00

Rates & Methods Available

<input type="radio"/> Express Mail® International  (Calculate Guaranteed Date) Max. length 36", max. length plus girth 79"	3 - 5 business days	\$33.50
<input type="radio"/> Priority Mail® International  Max. length 60", max. length plus girth combined 108"	6 - 10 business days	\$28.00
<input type="radio"/> Priority Mail® International Large Flat Rate Box  USPS Supplied Large Box: 12" x 12" x 5 1/2". Maximum weight 20 pounds.	6 - 10 business days	\$55.95
<input type="radio"/> Priority Mail® International Medium Flat Rate Box  USPS Supplied Medium Box: 13 5/8" x 11 7/8" x 3 3/8" or 11" x 8 1/2" x 5 1/2". Maximum weight 20 pounds.	6 - 10 business days	\$43.45
<input type="radio"/> Priority Mail® International Small Flat Rate Box*  Maximum Value for Contents: \$400.00 USPS Supplied Small Box: 8 5/8" x 5 3/8" x 1 5/8". Maximum weight 4 pounds.	6 - 10 business days	\$13.45
<input type="radio"/> First-Class Mail® International Package*  Maximum Value for Contents: \$400.00 Other than rolls: Max. length 24", max length, height and depth (thickness) combined 36" Rolls: Max. length 36". Max length and twice the diameter combined 42"	Varies by country	\$10.76

Options Available

Extra Services	Price	Your Cost
<input type="checkbox"/> Certificate of Mailing	\$1.15	
<input type="checkbox"/> Registered Mail™	\$11.50	
Your Total (Includes First-Class Mail® International Package for \$10.76)		\$10.76

Option 1

- Certificate of Mailing
- You can prove you sent it with Certificate of Mailing.
- When you need to verify that you've sent a letter or package - purchase a Certificate of Mailing.

This doesn't help the buyer at all... it just proves we sent it & we can already do that with the receipt.

Option 2

- Registered Mail
- Items you send with Registered Mail are placed under tight security from the point of mailing to the point of delivery, and insured up to \$25,000 against loss or damage.

This is the only way you can insure a package of this type & we have never

offered it, for obvious reasons, until this buyer requested it on a subsequent order. It will not be offered again... first & last time! When they said tight security they meant just that! Our package had to be opened at the USPS window, transferred to a new box of the same type in plain view, hand labeled & more forms filled out by our postal gal who said she'd never do it again because of the jeering by other waiting customers. They supplied her with a special brown tape to seal all edges & then it was on it's way... costing us another half hour wage for the postal gal who won't do it again, anyway.

Although this sounds good on the surface, the buyer is paying \$11.50 to insure a \$15 item & the terms of this... far to long to list here... is that the package must be over 60 days past due before a claim for the \$15 can be submitted by the addressee along with one or two other filled out forms for investigation. I assume the only way a person overseas could get the forms would be online at the USPS site & they'd have to be downloaded, if available, because the maximum time for the claim is 180 days... a short window, for sure.

The supervisor told me that there is no tracking available for the registered mail & that tracking was only available for the Express Mail at \$33.50. A bit extreme for what you can actually track & at more than double the cost of the item! I asked about insuring packages another way & you can buy insurance on an any Priority shipping, but it seems that there are just as many hoops to jump through when trying to submit an out of country claim & the wait can be even longer! Keeping in mind that there have been no lost packages in 15 years, in or out of country, if it's still worth it to you we'll buy insurance on your behalf, such as it is, for Priority packages. Another rule to this is stated insurance or registered value must be listed on your customs declaration exactly as on those forms, as well. Any deviation can render the insurance null & void.

Buyer's Concerns

Buyer:

why is it not your responsiblity?you sold the item.

Reply:

First-Class Mail® International Uninsurable [At Your Risk](#)

From ordering FAQ:

Yes... I will ship uninsured on a per order basis at your risk. Be advised that you are risking the amount of the total order in case of loss or damage. This is applicable to cross shipped orders, as well. It is one thing to say ship it uninsured and I will be responsible if anything happens, and quite another if you receive a \$150 package that was thrown under a moving mail van's tire to stop it from rolling down the hill. Remember, no one wants to pay for a dead horse except the mucilage manufacturer :(

Buyer:

its your responsibilty to ensure the package is recieved by the buyer,or dont you give a flying one?you send a package to bradford uk,you address it to some other customer in france by accident and then you dont give a s**t?you got no proof you sent it,you got no proof you even sent it to me and now you are trying to say its not your responsibilty?

Reply:

If we screw up for the first time & send your package to some guy in France, our receipt would show that & we would certainly dig into our pockets to make it right, even though the item was sold at a loss to begin with, because it would have been our fault & not independent mail handlers! We have all your records here & here's a simple copy of the receipt that shows your item was sent when we said... your named files protected the receipt surely does not say France.



Buyer:

you keep on hoping, too right it's your responsibility to ensure the item you sold is with the customer, if there's a screw up with the postal service you go and you check with usps at your end first before you go blaming the postal service here in the UK and asking me to check. The buck starts with you so you get off your ass and you go check and then when you confirm you have it I will wait. I already told you, your package could be in 10 parts in a bin at your local usps sorting office, your package is not insured or tracked so it's an expendable item which means it can be thrown and no one will be any wiser but the person it was supposed to go to.

Reply:

There is nothing to check with the USPS here. I could wheel my chair right up to the window, show them the receipt & they would ask if the addressee had purchased the \$33.50 Express mail with tracking & I'd have to say that you didn't... don't blame you, either... I wouldn't! You confirmed shipping of the package via First-Class Mail® International Uninsurable, which at \$10.xx is a bargain & has been successful by all those before you & I have no doubt that it will be successful for you, as well, albeit a little late.

I don't blame your mail service, although many of your fellow countrymen do, I only

suggest you check with your local PO & customs as 15 years has taught me that whenever a package is late it can usually be found on a shelf at the local PO or at customs. I can only reiterate that no packages have ever been lost and of those delayed, not a single one was found at one of my sending POs.

Buyer:

at least act like a decent seller,after all i hear nothing but good things about you but,i wanted the package info and you sent me email saying that was for your benefit,i dont pay \$15 more for recorded delivery for your benefit mate,you should be charging this or offering it as an option.up to now i have not recieved the package after today its 17 days,thats to ensure it gets peoples attention,its not discardable now and if the same happens again you will see,would not suprise me at all if the same repeats itself and its 17 days for the next parcel and its not here.

Reply:

Alice & I have given up our retirement plans to stick around here helping hobbyists get the parts they need at cost for the most part, using our many years of contacts while in the coin-op business for 40 years & offering free to all advice & seeking only to break even at the end of each year. In my case, that is giving up 140 hours average per week that I could be spending on the beaches of Aruba or trying to actually make a fortune at this late stage in my life. For you, I call that a decent seller... for me...well... it keeps the rust off & saves me WD-40. Alice, although not able to keep to my rigid pace, has sacrificed far more than her time.

Okay... you did not spend \$15 for a registered package on the late one. I told you that the \$1.15 signature was only something for my benifit as outlined by the USPS above. You asked for a copy of the registerd mail for the 2nd order & I supplied it even though they say it will do you no good at all as none of that info is communicated to your postal system... it cannot be tracked even by a bloodhound!

Let's see... I guess you think that I have ripped you off somehow... on two packages now! I suppose you could ask the other 8,254 people who have ordered from us if they ever felt they were ripped off? 17 days! 17 days! What a sliver of time in the overall scheme of life... hopefully, one would have more patience than that.

Buyer:

the parcel might arrive today but,you can be sure if it does i will email you with the good news.

Reply:

I will be as delighted as you when your package finally arrives.

Buyer:

you aint the postal service,its not your job to deliver a parcel,as a seller its your job to ensure the item is dispatched and that the person its dispatched to gets it.

Reply:

Let's see... I should not only give you a helping hand, but I should insure that you get your cross shipped package in an exact amount of days even though you chose to

have it shipped in an inexpensive way that is exact in time for a majority of buyers.... and let's not forget... of which not a single one has been lost!

Buyer:

when you sent that parcel was it great britain and n ireland i see stamped on it?it looks it to me.last time this happened the package went to ireland and it took a month to get to me.i live in england and i am sure i gave you my address for the midway kit and told you to put england on it,i just cant confirm it as i dont have the sent emails.as i had hassle with a coin door and didnt want to go through it again,if i didnt then my bad.

Reply:

I can write England all over the package, but I have no say in what the USPS does with the channeling.

Country Conditions for Mailing — Great Britain and Northern Ireland
(Includes England, Scotland, Wales,
Northern Ireland, Guernsey, Jersey,
Alderney, Sark, and the Isle of Man)

You never gave me your address at any point throughout your emails. Your address was gleaned from auctionchex.com.

Buyer:

i told you about the midway coin door?i can even tell you the sellers name and you can ask them yourself what happened.i had to buy a replacement from xxxxxx and it came after a week after i had the xxxxxx door,i still payed the guy as well as i bought it off him on ebay but,he refunded me and i aint one to take advantage even though he refunded me and said if it turned up just keep it as i know he realised it was not my fault and he sounded gutted from his email.

Reply:

Sounds like your seller was a for profit business on eBay & quite often the price the item sells for is double or more the investment in it, so giving you a second one at no charge is very easy since you paid the full amount in the first place the seller giving you another item is breaking even... where we start to begin with!

Personally, when things have happened to me like the above, it has turned out to be a stall for time to find the item that was sold to me, but was not on hand & had to be found & shipped to the seller before it could ship to me. It explained away pic differences for the seller, as well as, buying the time. It's when they oversell & cannot cover themselves that you actually end up the loser!

So to any future overseas buyers who happen to have missed our shipping policies I hope this better explains them & if you are not one willing to gamble, or are just impaient, please order elsewhere... we'll be glad to help you through a third party site if that's what it takes.

Follow-up:

it arrived today after 19 days.so put me down for the record.

at least i know that your honest and at least the parcel will finally arrive.but,it definately got held up for a long time along the ay.before this one the longest was 14 days and the package was in usa for 7 days.but,i still prefer tracked recording that way it saves arguements or disputes.

Cross Shipping

8/01/12

Looks like cross shipping works smoothly for about a year at a time now. I guess no one took Alice seriously when she said the first time anyone goes over 10 days they get removed from the cross ship list because just since the first of the year, the list has been reduced by roughly 15%... some of which we had been helping for years. When you are use to receiving your order 2 days after you place it, & then suddenly have to add on a 3 to 6 day wait while your payment is enroute to us, it can be disappointing to say the least. It can mess up a planned weekend of repairs for sure.

5/01/11

Over the past couple months cross shipping payments have been backing up once again. Out of a box full of invoices approximately 10% of them are past Alice's allotted 10 day period for receiving payment. Alice says she has been generous in giving everyone second & third chances on late payments, but wanted me to forewarn everyone that she is taking anyone off the cross ship list that has gone over the 10 days without exception from now on. She says it's only fair to those who do cross ship their payment without fail & I have to agree with her.

4/16/2010

Unfortunately, cross shipping is once again in danger of being halted, as it was back in 2004. It seems many people have forgotten just what cross shipping is... which is just a way to speed your parts on their way to you by shipping them when you send your payment, so that they cross in the mails, saving 2 to 4 days of transit time. Alice handles the cross ship list of regulars & she allows 10 days for US payments to get here & 20 days for Canadian payments just in case the USPS sends your mail on an extended trip before stopping here. Lately, she tells me that more often than not the Canadian payments are arriving within 10 days & she has to send notices to US buyers at the 10 day mark. She says it's evident that many have gotten away from their end of the cross shipping bargain by replies to her "heads up" notices. A few examples are: I'll send it this weekend or I'll try to send it out next week, this when it has already used up the 10 day grace period & obviously not "cross shipped".

Needless to say, Alice is a little ticked over this & she says it's because she increased our exposure cap for cross shipping by a thousand dollars at the end of last year & we are bouncing off the new fully exposed position almost daily, which in turn, causes some packages not to be shipped on the day the order is placed. Because of that, she has been knocking off the list all those who go over the 10 day grace period in order to ensure cross shipping for those who do adhere with timely payments.

When everyone lives up to their end of the bargain cross shipping works like a well oiled machine as proven over the past 14 years. The 10 day grace period encompasses those who like to place their orders on a Wednesday for the parts they need for the weekend & send payment on Friday when they get paid. Alice says she's fine with that since these payments never seem to be late. Before the wheels starting coming off this system she was even cross shipping to newbies who emailed that their payment had been posted & she said that those were no problem at all, but being at the limit of exposure doesn't allow her to do that most days here of late.

Hopefully, this is just another bump in the road & everything will get back on track, but it all depends on having the payments cross shipped to keep the pool full & capable of sustaining the float of goods in transit.

Eliminating Shipping Errors

I get a lot of comments & specific mail asking how Alice & I manage to keep orders virtually error free, so I thought I'd put together a quick overview here. Who knows, maybe it'll help someone else.

When we first started shipping we were spending a great deal of time in checking & double-checking each order. Actually, we had 3 sheets for each order... a pull sheet, a double-check sheet & a packing sheet check list as each item of an order went into the package. We alternated going over the orders because we found that double-checking yourself would sometimes end up with you making the same error a second time... something like watching a whodunit for the second time & making the same plot errors as you made in the first viewing even though you had seen the ending once.

The thing that has freed up time & helped us the most was something rigged up for an entirely different reason. We had quite a few new & used monitors left in stock when I retired & I was hesitant to sell them due to shipping issues, so I called the PO & asked about shipping them & if they were insurable. I was told to protect them well & to take pics of different stages of the packing as proof of prudent packaging in the event that something was broken in shipping. I asked about video taping the packaging as proof & was told that was an excellent idea & that I shouldn't have any trouble with a claim as long as it showed the packing was sufficient.

Well... I had an old Sony camcorder that I used by hand for the first few shipped, but that was awkward & required both of us... sometimes even needing to enlist an unsuspecting third party. To make this easier I mounted the camcorder on the ceiling looking over the shipping table. This worked much better. Somehow, I got carried away & hooked up an old Packard Bell PC that had a TV card & a nice video capture program... just a toy after the monitors were all shipped. The grandchildren watching themselves on the screen & wanting snapshots which I moved to this PC via floppy disk after capturing & printed out for them :-)

Then one day I decided to just run the setup during the day while getting packages ready & in just watching the tape... a boring event...I noticed that it was easy to get the parts put in a wrong package since they were sitting side by side on the shipping table separated by supermarket conveyor belt dividers. That was enough for me to change over to using bins & keeping them far enough apart to prevent this. I said to Alice that this would be a good way to check things if it wasn't such a boring job that consumed so much time. She, being the smart one of the duo, said you can always run it everyday & when someone reports a mistake just look at the tape of that day to see if you can see what happened. Hmmm... good idea!

Well... I rigged it up on an AC adaptor & put a VCR in line, so that I didn't have to deal with loading the camcorder. Then I got a case of blank RCA video tapes when they were having a give-away sale & started popping one in at the start of every day to see if this would be beneficial. I was about to give up after 30 days & not needing to even check one out, when I got a missing complaint. Yea! I looked up the day the order was packaged & pulled the tape. It wasn't as easy as I thought to get to the right order as I had to keep

fast forwarding to each one trying to match up goods & had some close ones where I'd have to view the whole packaging before discovering it wasn't the right order, but persistence does pay off & I found the right one. As I was watching it I knew positively that it was the right order because I found the missing part & plugged yet another shipping error possibility. We had a tall slender trash can beside the shipping table, but lower than the table & positioned so that half of the opening was under the table. What happened was that another part being dragged as it was picked up to place in the shipping box had brushed up against the AWOL part & shoved it just enough to drop right into the trash can totally unseen, or unheard, since all the peel off adhesive covers are thrown in there :-)

[Note: To eliminate this I put a chute in the table that extended above the surface, so that you have to physically pick up a piece of trash to toss it into the can now under the table.]

The tapes were instrumental in finding & eliminating any faults we had in handling the shipping... and neither of us wanted to be caught on the tape making an error, another plus... and in a couple instances found parts on the receiving end after viewing the tape for the exact location in the package. It is seldom needed anymore & still boring to view, but I got lucky in having a daughter who likes to find things on the tape :-)

I have changed it around several more times over the years & have it where it is basic & simple now. A JVC camcorder lowered off the ceiling to just over the packaging table... I tried PC cams, security cameras & other methods, but the camcorder seems to be the clearest & easiest for us to use.



The TV/VCR combo allows me to look over Alice's shoulder during the packaging operation as it is being taped... another handy convenience :-)



The zoom allows us to get up close on items that have been combined into a single bag, such as placing a G07 HOT inside the G07 cap kit bag.



With the camcorder pointing straight down it can zoom in close enough to read the fine print on a coin.



The JVC has a remote control which comes in real handy when using the zoom. As you see above, the remote is sealed in a plastic bag. I do this with all remotes & usually when the device it controls is totally worn out the remote is still as new when removed from the plastic.

While this helped to clean up any shipping errors caused by environmental influences, the good old double-check system still has to be implemented to take care of those human errors. Fortunately, or unfortunately, we've had 5

total mistakes this year between us... with one having more than the other... not mentioning any names :-() Being a perfectionist makes me a little uneasy with that many mistakes, but I'm learning to live with it.

Did I say just a quick synopsis at the beginning of this?? As usual, many hours of rambling over nothing! I'm getting too old :-(I just hope one person will glean some small tip from these ramblings.

Happy Gaming.....

PostScript: It's not my fault! If you don't want to know the answer, don't ask me :-)

Misconceptions

Okay... coming up on year eleven of Alice & I being here doing our part, as best we can, & I've read so many misconceptions of what we are doing here, & how we are doing it, that I felt it was necessary to add this synopsis to the site pages. Those that know me realize that I use the word synopsis loosely because this will most likely end up being another complete chapter! In fact, let me preface this with how we got to this point in the first place.

In 1996 I started planning for my 2000 retirement by selling off whole entities of my business. One of the first to go was the bingo machine business lock, stock & barrel to a long time customer... DBA Pinball Paul. Due to the advent of legalized gambling in Louisiana I had already sold off all gaming equipment & parts. Bingo had outs... and still does... as long as the equipment is 25 years old or older. Next was jukes & parts in a bulk sale. Then pinball stuff sold off to 2 separate companies, electromechanical to one & electronics to another. Then the pool table & accesories complete... still dissecting the whole. The video games, still booming, were the mainstay of the business & what I held onto the longest.

It seemed that the few buyers for the video stuff wanted a million dollars worth of parts for a thousand dollars, or less, and I just couldn't see giving it all away to someone who would no doubt demand a premium for each & every part. Another concern I had at the time was that I had seen what happened to my peers' spouses & families as each prematurely checked out :-(Some didn't wait but a day or two before approaching the family with offers of 10 cents on the dollar for their inventory or business. I made up my mind I definitely didn't want to leave my family in that situation.

Some of my ops suggested that I try to sell off the parts myself on the internet & directed me to RGVAC. I reluctantly began reading the newsgroup & offering parts to those who posted items wanted, and that I had, via email responses. Then I started offering advice in email to those that requested it. Before long... sometime in 97... collectors had drawn me out of my quiet corner & into the newsgroup answering Qs where many would benefit from the answers.

In the meantime, a local distributor decided to get into the building of vid games for sale & offered to buy out the last bastian.... video! We struck a deal for all the new video game building materials.... cabs in states from raw to finished games & a majority of the parts to build the newer games of the late 90s... from line cords to fluorescent fixtures to monitors.

Now all I had was a gazillion parts for classic games & electronic components with a 1st refusal offer to buyout this lot in 2000 upon my retirement... at my option. As time elapsed I made more & more friends via the newsgroups & got so many requests to stay on & supply parts & advice, that Alice & I decided we could do just that.

So many were requesting that I buy in new parts & not let my years of contacts & mfr's discounts go to waste, that I decided to buy in only common parts that didn't hang around a long time & that could easily be sold off if I met with an early check out call!

Now, so many years later, Alice & I are still here providing the same service for the arcade game community from our home... now a warehouse in & of itself, & without a single nagging word from Alice! [Reminds me of a time some 35 years ago when I bought a chicken coop warehouse full of trade-in TVs &

had to stack them up in our home... every room nearly to the ceiling... and every one that saw them asked why Alice had not yet shot me :-)]

Well... that's how we ended up here & not on the beaches of Aruba as previously planned. Now I'll address the misconceptions that have come to me via email, whether in questions or links to sites or newsgroups.... incidently, I wouldn't even know how to respond in a NG these days as all my time is spent right here behind the keyboard... ball & chained :-) Keeping busy keeps the rust from forming, though!

The first bizarre thing that one emailer relayed to me was that someone had told him that all I do is shop sales around the world & load up on stuff that is on sale & then sell it for a huge profit! Profit! What's that? We strive to break even at the end of each year, and if any sales actually come our way the items are cost averaged into inventory lowering the price you pay, at least till all that stock is gone. Individually, there are many items that are at huge markups & these are the things often requested that are small, take up room in our home, hard to locate once someone wants one & usually accompanied by a list of other small parts which take Alice, or usually me, hours to find. I see why many retailers want you to buy large lots of the small items. These items are only stocked as a convenience to you when buying other parts at wholesale cost... or below.

Once in a while, someone will email me to tell me one of my suppliers has something on sale at a lower cost. I can't determine prices for other people & sometimes their sale price is at my cost from them, but then I have to add on their shipping costs & I also have to add on sales or use taxes, which I pay for you... another hidden cost. Sometimes the supplier will spark up sales on something that hasn't been moving by selling below cost.... no way I can lower to that level, but whenever possible I get as close as I can & simply reorder anything I sold at a loss before their sale ends to replenish inventory.

Lately, I've been getting a few people saying they would buy from me, but that they don't want to wait for me to receive a check from them & then wait for it to clear my bank. I've gotten a couple links to sites that proclaim that we do that. Well.. neither Alice nor I have ever waited for a check from anyone to clear a bank... we'd be a lot grayer than we are if we worried about such trivial things. We both believe a person is honest until proven otherwise.

This year I've had several people place orders for the first time since 1996/7 & when I ask if they've been away from the hobby I get answers similar to this... it takes too long to complete the deals because we have to wait for you to receive the payment before shipping. Well... as anyone who has been with us since the late 90s can tell you, we do cross ship orders for all established regulars in the USA. We have been trying to include Canada this year, as well. You get your order in 2 days where as some places don't even act on your order in that amount time & then take a few more days to actually get it shipped. The cross shipping has had 3 bumps in the road over the past 10 years for short periods of time, but as you can see from the short [Bad Trader List](#) it has worked well for the most part & proved out our theory of most people are honest. I take people at their word & often times cross ship a first time order when I get an email saying the check is in the mail. Even on new orders that do require the check to be in my hand, the total time of the completed transaction is 4 to 5 days... from the time you mail the check.

On PayPal... I did get a prospectus in the mail from PayPal & after reading that they would be in control when it came to any & all disputes I opted not to use them. As it turns out, I realized it was a good decision when they notified me that there was a problem with my non-existent account! Seems someone was able to open an account in my name! Businesses operating for profit can afford to open a separate bank account

just for PP, thereby limiting their capital exposure to PP's whims, but in our case it would only push prices closer to retail & defeat the purpose of our being here. In any event, it's a moot point since LA is one of the 3 or 4 states in which they have been asked to cease operating in. The stories that lead up to this can be found on one of these two sites... [Site 1](#) or [Site 2](#). As I have said before, PP is probably fine for the individual because the most they can be out in a dispute is the amount that is in their checkbook at the time. You might end up in another dispute with your mortgage holder, but no life altering consequences.

Cross shipping negates the need for a third party to have their hands in the middle of your deal, anyway. A recent first time snafu with cross shipping came about when a person on the cross ship list received his order & said he wasn't finished compiling the order yet. If you are on the the list, your package will ship the day you place the order, or the next if it's too late in the day... so if you're building a shopping list don't send it to me before it's done or you'll end up with your partial list being shipped to you. It was mentioned that the items didn't total much in comparison to the shipping charge, but there are more orders shipped under \$5 than above \$5, so I have no way of knowing which camp you are in. I have shipped one fifty cent resistor across the river from me for a total of \$6.50 which the person thought to be a bargain because of the time saved, the gas, the bridge toll & fighting the traffic. On the other hand, I've had people that wanted to keep adding to their order until they reached the maximum they could get shipped for the \$6. It's all just personal preference & everyone has their own reasons for their choices.

From time to time I get emails telling me about suppliers that have cheaper prices... I don't always find the cheapest supplier & sometimes the people supplying me actually buy from the places that are pointed out, so I always check these leads. Sometimes they pan out... sometimes they don't & sometimes the next time you go to check the sites you find this:

" Oops! Page Not Found " telling you a little something about shopping known suppliers.

Well... I'm going to leave the book open to this page & whenever I get an email telling me what we are about I'll reply right here :-) Afterall, reading this page might help you to go to sleep on one of those restless summer nights :-)

Happy Gaming....

January 28th 2013:

We clung to the 2009 shipping prices for as long as we could, but with this fourth postal increase the losses are just too great :-() Unfortunately, out-of-country packages have taken the blunt of the increases.

USA

Large Flat Rate Box No Insurance	\$16.00
Large Flat Rate Box Insured \$100-\$200	\$20.00
Large Flat Rate Box Insured \$201- \$300	\$22.00
Large Flat Rate Box Insured \$301- \$400	\$23.00
Large Flat Rate Box Insured \$401- \$500	\$24.00

Canada & Mexico Max 20 LBS

Large Flat Rate Box No Insurance	\$54.00
Large Flat Rate Box Insured \$100-\$200	\$59.00
Large Flat Rate Box Insured \$201- \$300	\$60.00
Large Flat Rate Box Insured \$301- \$400	\$61.00
Large Flat Rate Box Insured \$401- \$500	\$62.00

What can I fit in a large flat rate box?



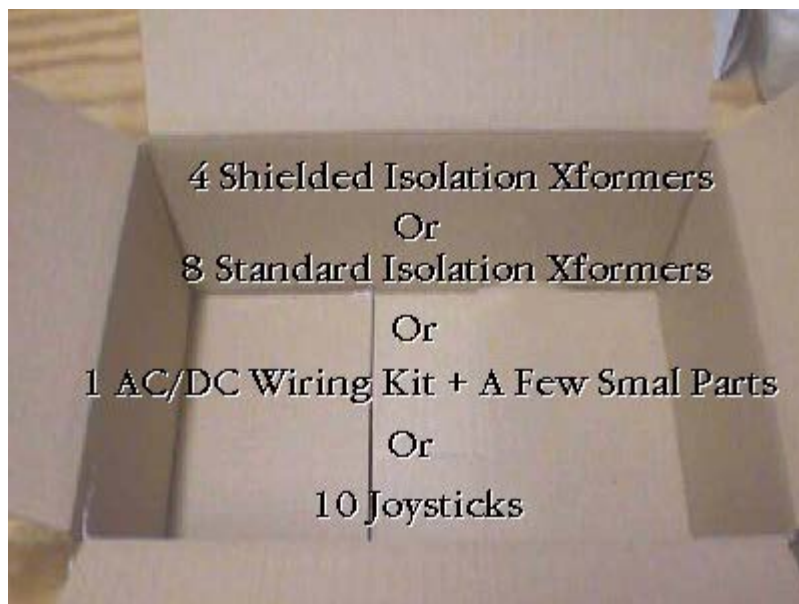
Minimum Domestic Shipping Rate To 1LB	\$7.00
Minimum Foreign Shipping Rate To 1LB	\$10.00
Over 1LB Online Calculator	?????
Med Flat Rate Box No Insurance	\$12.00
Med Flat Rate Box Insured \$100-\$200	\$15.00
Med Flat Rate Box Insured \$201- \$300	\$17.00
Med Flat Rate Box Insured \$301- \$400	\$19.00
Med Flat Rate Box Insured \$401- \$500	\$20.00

Canada & Mexico Max 20 LBS

Med Flat Rate Box No Insurance	\$41.00
Med Flat Rate Box Insured \$100-\$200	\$46.00
Med Flat Rate Box Insured \$201- \$300	\$47.00
Med Flat Rate Box Insured \$301- \$400	\$48.00
Med Flat Rate Box Insured \$401- \$500	\$49.00
Minimum Rate Canada & Mexico	\$10.00
Minimum International Rate	\$10.00

What can I fit in a medium flat rate box?







Big Bear's Bulletin Board



These are the "Ramblings" of Bob Roberts and may not necessarily be the popular consensus, but rather things that have always worked for me, along with some "How to's" and ideas I have picked up on over my 40 years of *fixin'* coin-op stuff. My intentions are to make this as basic as possible, so that newbies can grasp the concepts readily.

I know there is a ton of info lurking up here already, and hopefully this will not be a duplication, but rather a further help to the newbie or the full fledged collector/tech. No techie stuff! Use info at your own risk, although I am still kicking...I might just be lucky :)

This page made possible by:

Tony D. Berry

Thanks

Just Stopped By To Pickup A Few Game Parts?

BOB'S PARTS PAGE BACK DOOR

[**A Chicken Little Story**](#)

Problems With A/R Bds In Atari Games

[**Atari's Big Blue**](#)

Symptoms Of A Bad Filter In Atari Games

[**Bridge Rectifiers**](#)

Identifying Types Of Bridges & Polarities

[**Cheap Audio Amplifier**](#)

How to make a cheap audio amp for adaptors

[**Crimp Mystery**](#)

Proper Crimpers & How To Use Them

[**Defender Rom Board**](#)

Help With The Williams Defender Rom Board

[**Donkey Kong**](#)

One Way To Use A Newer Switching Power Supply

[**Fluorescent Lighting**](#)

Testing Marquee Fluorescent Fixtures

[**G07 Chassis Repair**](#)

Guide To Repairing An Electrohome G07 Chassis

[**Acronyms & Abbreviations**](#)

Commonly used acronyms & abbreviations

[**BloodStorm**](#)

JAMMA Pinout For BloodStorm By Strata

[**Cam Locks**](#)

Which Locks Are Needed & Installation

[**Coin Mechs**](#)

Help With Replacing Coin Mechs

[**DC Pac Harness To Jamma**](#)

Using an adaptor to test Jamma bds in Pac cab

[**Diodes**](#)

Which Way To Install Diodes

[**Eprom Programming**](#)

Using A Programmer & Programming Voltages

[**Free Play**](#)

Rigging Your Game For Free Play

[**G07 Filter Capacitor**](#)

Replacing the G07 B+ Filter With A Modern Type Filter

[G07 Model CAO](#)

What Cap Kit To Use On The Older G07-CAO

[G07 Sync Upgrade](#)

Upgrade To Accept Newer Type Sync Input

[G07 Last Resort](#)

You've done everything & still the chassis is dead

[Good Cap - Bad Cap](#)

Quick Testing Large Filter Capacitors

[Great 1000Mile Rally](#)

Hooking Up The Steering Wheel & Other Notes

[Grounding Your Game Cab](#)

Wire Size & How To Run Ground Loop

[I Want To Build A Game](#)

Guide To Assembling A Game's Components

[Illuminating Pac Buttons](#)

Installing & Lighting Translucent Start Buttons

[JAMMA Harness](#)

How To Install A JAMMA Harness

[Joystick Notes](#)

Solutions For Possible Joystick Malfunctioning

[Konami 3 & 4 Players](#)

Pinouts for Konami 3 & 4 player sub-harness

[Leaf Switch & Button](#)

Solutions For Using Leaf Switch Buttons

[Monitor Extension Cable](#)

How To Troubleshoot Using Another Game Or Monitor

[Ms Pac Speed Up](#)

Installation Of Speed Up Or Slow Eprom

[Mud Red Jukebox](#)

Quick link to the often asked about jukebox story

[My Notes](#)

What's left of my old notes page

[Pac-Man Sockets](#)

[G07 Shrunkn Picture](#)

What To Do After The Cap Kit Is Installed

[G07 Vertically Challenged](#)

Causes For Vertical Collapse

[Get The Yoke](#)

How To Fix Pic Mirror Image Or Upside Down

[Ground Via Earth](#)

What Is Earth Ground & How Is It Hooked Up

[Greyhound Poker Board](#)

Pinout for Greyhound poker & trivia boards

[Gun Troubleshooting](#)

Solutions For Lethal Enforcers Gun Problems

[Ice Cold Beer Fix](#)

Replacing The Belts On Taito's Ice Cold Beer

[Isolation Transformer](#)

Stopping The Buzzing In An Isolation Transformer

[JAMMA Plus](#)

Solution For Adding Kick & Punch Extra Buttons

[K7000 C36 Retrace Cap](#)

How To Replace Older 4-Legged Critical Safety Caps

[Lamp Sockets](#)

Tips On Coin Door Lighting

[Monitor ID Page](#)

Pics Of Chassis' To Help Identify Your Monitor

[Monitor Orientation](#)

How to distinguish between vertical & horizontal monitor problems

[Ms Pac-Man Wiring](#)

AC & DC wiring of a Ms Pac cabinet

[My Pac Is Drunk](#)

Solutions For Weaving, Humming & Black Bars

[Pac Adaptors](#)

How To Build A Pac Adaptor To JAMMA Adaptor to use a switcher with OEM Pac wiring harness

[Pac-Man Switcher](#)

Brown Intermediate Sockets For 5S & 6D

[PCB Edge Repair](#)

One Way To Cope With Bad Edge Pads/Fingers

[Quick & Easy Video T-Shooter](#)

An aid to help track down video problems.

[SafeBack Discharger](#)

Building A Pic Tube Discharger

[Slanted Monitor Picture](#)

K4600 Monitor Problems & Solutions

[Sync Troubles](#)

Various Ways Of Connecting The Monitor Sync

[Test Fixtures](#)

Building A Test Fixture or Test Jig

[Trackball Bearings](#)

Trackball Bearing Maintenance

[Trackball Troubles](#)

Using The Trackball To Test Itself

[Tron Power Supply](#)

Repairing The Midway 90412 Linear Power Supply

[Using An Ohmmeter](#)

Using An Analog Meter For Quick Test Results

[What Wire Gauges](#)

Wire Size Needed For Cab Wiring

[Wico Trackball Revival](#)

Bringing An Old Wico Trackball Back To Life

[Williams Battery Conversion](#)

Getting Rid Of The 3 AA Batteries

[Williams Decoder Help](#)

Covers some decoder problems. Adding PS 5 volt adjust & changing sockets.

Making An Adaptor To Power Pac With A Switcher

[Power Supply Tester](#)

Using another game to test your power supply

[Resistor Reader](#)

Enter Color Bands For Resistor Value

[Singing Monitor Trouble](#)

Solution For A Whiny Monitor Flyback Transformer

[SPM To JAMMA Adaptor](#)

Building A Super Pac-Man To JAMMA Adaptor

[TB Test Fixture](#)

How I test trackball units before shipping. Monitor collapse tips.

[Trackball Units](#)

A Look At TB Unit Changes Over The Years

[Trackball Illumination](#)

Illuminating A Translucent Ball In A TB Unit

[Transformers](#)

Q & A's On Power Transformers

[Using Radial Cap Replacements](#)

Replacing axial lead caps with radial lead caps.

[Video T-Shooter](#)

Building A Quick & Easy Video T-Shooter

[Wico Command Control Trackball](#)

Trackball Used With Home Games

[Width Coil Adjusting](#)

Adjusting A Width Coil - What Not To Use

[Williams Coin Door Lamps](#)

Addresses Other Issues When Using A Switching Power Supply

[Williams Service Switch](#)

Simplified wiring for bench jig service switch.

Bob's Map Aids

[Amplifone Cap Map](#)

[G05-801 Cap Map](#)

[WG K4600 Cap Map](#)

[WG K6100 Cap Map](#)

[Basic AC Wiring Map](#)

[G07 Cap Map](#)

[WG K4900 Cap Map](#)

[WG K7000 Cap Map](#)

[MC-2000-S Cap Map](#)
[Nintendo Audio Bd Cap Map](#)

[MTC-9000 Cap Map](#)
[Pac-Man Bd Cap Map](#)

[Atari Trak Ball™ Maps](#)
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[Midway 90412 PS Board Map](#)

[Cherry Switch Map](#)
[Defender PS Board Map](#)
[Midway 90411 PS Board Map](#)
[Midway 90421 PS Board Map](#)
[Super Pac-Man>JAMMA PO Map](#)

[MK Plus Map](#)
[Stargate & Up PS Bd Map](#)
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[Williams Ram Layout Map](#)
[Wms Stargate Rom Bd Layout Map](#)

[SF 2 Plus Map](#)
[Williams Decoder Map](#)
[Wms Defender Rom Bd Layout Map](#)
[Williams Sound Board Map](#)



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My Chicken Little Story

by Bob Roberts

One thing I have learned about newsgroups over the years is that they are stupendous breeding grounds for "Chicken Little" stories. Everyone seems to have their own & I'm no exception. I have this haunting, reoccurring, sky-falling-in story that keeps coming back at me about every 8 months, or so, dating back to 1996. Every time someone has a problem with this particular item it suddenly becomes a bad part supplied by Bob Roberts and I get a mailbox full of email telling me it's being discussed on the NG, always a handful of email saying they got a bad one from me & a bunch taking aim at my supplier, as well as, many telling me what I should do or where I should buy to eliminate the problem. I am appreciative of any feedback, but in this case where no problem exists to have it coming back over & over again....
oui!

Here's my quick reply... there is not a problem with the part, has never been a problem with the part & I don't expect there ever will be a problem with this part. Now I'll tell you why I know this.

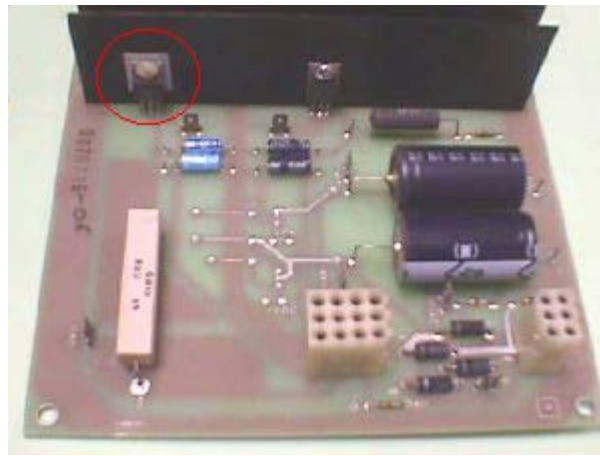
I could keep talking about this part in the blind throughout, but I'm going to bring it out into the open here & now for better reference. My "Chicken Little" part is the 7905 regulator. I've never found a bad regulator of any kind, straight from the mfr's tube, *ever* & I've been working with regulators a long, long time now. K... how do I know....

My supply of 7905s from my business stock ran out in 1997. Since that time I have reordered them no less than 20 times through 7 different sources. I'd have to be the most unluckiest person under the sun to have gotten bad parts that many times from that many sources... and, incidentally, 4 different brand names that I can recall. Is that it? No! Since it is all sales final I do check everything that I can prior to shipping and the 7905 is no exception. When parts come in I take a sampling to test from the various tubes... maybe one from an end & one from the middle. This is for my protection because if I ever really did get a bad batch of anything & didn't find it out until my old stock was used up... well... by that time any report that I made to the supplier would be laughed at. In fact, it takes a Philadelphia lawyer to get a supplier to take back something on the day that you receive it when they send you a wrong part, let alone a defective one :-()

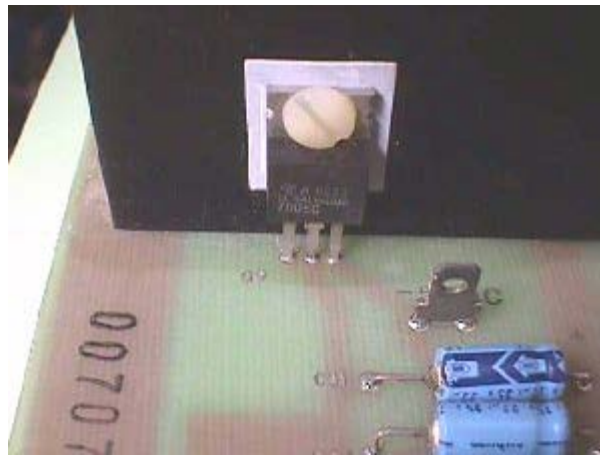
For your protection I test the parts just before shipping, or sometimes... when I'm looking for a break... I'll sit down behind the scope & test a complete batch at one time. I still test each & every power supply that comes in & I have not found a single bad one yet in all these years, yet I keep doing it because as sure as the sun rises, if I skipped one it would be a dud :-() Parts that are used in any of the kits that we put together I test when transferring them from the shipping tubes to the kit bins. Such is the case with the 7905... each & every one of them has been scoped prior to going into a kit & are known to be good from the mfr.

Is that all? No... I have checked through my email archives & found another interesting fact. No one has ever reported having a problem with the 7905 in the majority of uses... about 60% of them! The only recorded problems are all germane to the Atari A/R boards. Hmmm... they work in every instance except when installed on A/R bds? I don't think so & I will add in here pertinent notes to A/R bds.

First off, almost every app in coin-op uses 1 amp 7905s, e.g., L7905C, but I always buy in the heavier duty 1.5 amp regulators in hopes of added longevity. As they say... they should take a lickin' & keep on tickin'. My current stock is factory fresh delivered in April of 2005 & mfr'd by ST Micro.



K... here's a pic of the 7905 as used on the dreaded A/R bd that seems to reject them. The first thing that should be obvious is that the 7905 needs to be isolated from the heat sink, unlike other apps where it may be okay to fasten directly to the heat sink.



Here in the closeup you can also see that the screw needs to be plastic to prevent shorting to the heat sink. When changing this component if you use the old insulator you need to carefully check it to be sure it has no tears in it... absolutely use it or a new insulator... use heat sink compound to paste the insulator correctly on the heat sink with the holes aligned. Dab a little compound on the back of the 7905, put the legs thru their respective holes in the PCB, align the plastic screw & install it. Once tightened you can solder the legs & cut off any excess protrusions. Also, since the legs are so close together on the solder side check carefully to see that a solder splash has not joined any two legs together.

A few other precautions that come to mind are first do not overheat the solder joints when removing the old 7905 & be careful to have all the old solder removed from around the legs before pulling it out. The reason for this is that you may pull the thru-hole plating from the PCB if it is not completely free. The heat sink is at ground potential & the reason that the 7905 must be thoroughly isolated, so you can take an ohmmeter after installation & measure between the heat sink, the ground tab or any place you know to be ground, and the tab on the 7905. If it reads 10 ohms or under it is shorted & needs attention pre power-up. A typical reading after filter discharge here would be 5K ohms, so you can safely assume something is amiss with any reading less than a Kohm.

I notice in emails that a lot of attention is placed on voltages being wacky. This comes from attempting to measure them unloaded. Typical unloaded DC measurements would be as follows:

- Input from Big Blue 10.3VDC TP to 15 volts
- 12VDC TP to 14VDC+/-
- -5VDC TP to -15VDC+/-
- 22VDC TP to 26VDC+/-

-22VDC TP to -26VDC+/-

The -5VDC TP is more commonly measured at -7VDC unloaded, but in 2 out of 3 working samples that I pulled & tested I got -14VDC & -15VDC & as soon as I loaded them down... dead-on -5VDC analog! I've seen similar results in switchers & my guess is that the huge swings are attributed to the particular type used or in the way they are manufactured. K... curiosity got to me here. I just pulled the A/R bd that gave me the -15VDC unloaded & changed the Texas Instruments 7905C that regulates to -5VDC just fine under load with one of the ST Micro L7905CV from my current stock. Results.... -6.5VDC unloaded. What that tells me is that I shouldn't be concerned with an unloaded reading of the -5VDC since both components performed their tasks flawlessly & that's as far as my curiosity takes me at my age :-)

10/10/12 Note... And the beat goes on...

Twice in the last 10 days this has been brought up in email. One of them came back with a retort I've had a dozen times & have answered privately, but it needs to be here. First email... my -5 volts reads -15 volts. I say because it is unloaded. The second email reads... "I put the a/r board back in the game & I still read -15 volts on test point??" This is Atari games & here is why: Many of the game titles do not use the -5 volts, even when the schematic shows that it is, hence, the -5 volt reg has no load on it. The 1.5A does not have an internal compensating circuit like some of the 1A ones do. Sometimes a third email... "all the wiring is in my game right up to the edge connector." Yes... all the harnesses have the wiring in place, but if you go a step further & look at the pad on the PCB you'll notice it is a blank pad leading nowhere!

As a side note:

Another place I saw this in years gone by was in switching power supplies... back when they were worth the effort to repair. In games that did not need -5 volts reading at the PS terminal would typically be in the -13v to -17v range. Often times the the 12v would be way off, as well. Biasing voltages are not that critical on game bds, anyway. The voltage to be concerned with is the 5vdc & that is why it is adjustable. It should be set to read 5 volts on the 5 volt rail of the PCB, not at the terminal which may end up being as high as 5.5 volts due to load & line loss.

Some have noted wild & crazy voltages at the AC input to this circuit... 36VAC... and I believe this comes from improper measuring. The only reason to check this at all is if you wanted to know for sure that AC was being provided at all. Remember that AC is not measured with respect to ground as is the DC voltage. If you're looking for a close to 36VAC reading you'll have to measure across the winding, typically 2 red wires from the xformer in this Atari instance. I wouldn't be surprised to find the voltage off by 6VAC either way when measuring this. Since this winding is center tapped it does have reference to ground, but measuring from ground to either red wire will only produce half the reading, i.e., 18VAC & again, this is not something that needs to be dead-on... your meter may even read 25VAC & have the circuit function normally.

You really do have wacky voltages at the 10.3VDC TP & it's not working... time to check the bridge rectifier under the xformer assembly. The voltage appears to be correct, but it's not working... sub in a new Big Blue. Although the bridge & Big Blue are not directly tied to the other voltage circuits they can cause erratic readings in them, as well.

Well... that's my "Chicken Little Story" & I'm sticking to it... jeez, I hope not :-)

Hmmmm... in looking this over I noticed that I really haven't rambled far off topic... well... a loosely based topic :-) ... so, I'll share one of my wild stories from the past with you. It may have some relevance here.

Back around 1983 while out roaming the countryside for anything coin-op I could find to bring back here to Louisiana I stumbled across a mud red Seeburg jukebox in the warehouse of a Memphis, TN distributor. I asked what the story was on this mud ball & was told it had been through a flash flood. One minute it was allowing Elvis to sing out as only he could, and the next it was being tumbled around in the mud & water like a forgotten pocket watch in the washer. That's

just so much junk now and it'll never be good for anything, not even parts. If your interested in it you can have it for the taking. Hmm... I'd never seen such pretty red mud. Yes... I want it! I had already bought so much that my truck was pretty well loaded down... if I remember correctly, 13 pieces from that one warehouse... and the guy says I'll put it on the side for your next trip up here. What.... wait for my pretty new red mud ball... no way! I spotted a half dozen guys hanging around across the street, so I went over & asked if they'd be interested in sharing a case of beer. Everyone was interested! What did they have to do? When I told them I wanted to place a jukebox on top of the jukes already occupying my truck bed I was surprised to hear... which one & where do you want it. Took about 10 minutes total with me yelling take it easy... they were raring to just toss it on the pile :-) Anyway, I gave them twenty dollars for beer & they headed back across the the street to the corner bar while I strapped down the load with the mud red juke laying on it's back atop the others... coffin-like.

It was a beautiful summer day, so my canvas top sat folded on the seat beside me when I pulled out from the distributor's lot & headed home down I-55 with my overflowing load. Not 30 minutes into the trip I see this ominous, blackish-gray wall coming right at me! Yikes... I know what this is, so I pull over to the side of the road & quickly start covering the load with the army surplus canvas cover. I had just tied down the front when it hit like a raging storm at sea! Canvas flying in the wind, flapping on & off the jukes like someone shaking out a beach blanket. Rain coming down so hard that it felt like hail hitting me & felt as cold, to boot. I stuck it out & got the load covered... knowing what I know now, perhaps I shouldn't have. A half hour down the highway & the storm from hell is a thing of the past... I can only see it in the rearview mirror... and the sun is beating down so hot that opening my 260 air conditioning unit (both windows) dries me & the load off in very short order.

I arrive home without further incident & round up enough help the next day to retrieve my pretty red mud ball from it's perch high atop the load. Alas, it finds a place in my warehouse to sit & wait for some 8 months, until one 98 degree day the following summer when I decided to remove the pretty red mud to see what was underneath. I used a combination of my pressure washer & an ordinary garden hose in sensitive areas, to thoroughly wash it down revealing a pretty juke that looked like new. I left it to the hot Louisiana sun to dry it out & it seemed to have done a great job by days end, but I wheeled it out the following day for another day of sun just to be sure. Returned it to the warehouse where it sat for another week, or so, until I was out looking for something in the area & on a whim plugged her in. Lights, camera, action... she lives! Tossed some 45s into her library... she works! A little tinny, but none the worse for wear. Grabbed new needles & snapped them in place... sounds great! This baby is going in the shop for our entertainment! Muddy got moved into the shop area & loaded with 45s... lots o' Elvis, she liked him :-)

Muddy entertained us for nearly a year without a fault. Then an op friend of mine said he had to have her for a location & sang the right song for me to part with her :-(She performed well for him for the next 10 years without so much as a new needle, according to him. Then he brought her into the shop from location... around 1995... and asked me to perform surgery on her. Seems his customer wanted to join the new CD rage, but loved her so much that he couldn't part with her, so the op had bought a Sunshine conversion kit for me to install :-(Living through a flash flood, being pulled from the scrap heap, going on a wild & somewhat wet ride from TN to LA, surviving another flood of sorts, performing like a champ for 10 years in the field & now a renewed life as a CD box.... sounds only right & a fitting way for her to continue on.

Muddy played those CDs for some years before being sold & moved to FL where I hope she met with a much deserved retirement. I can only hope... never got so much as a post card from that time on :-(

Where's the relevance? Well... I could have sat down with a meter & gave her a complete exam, checking all her AC & DC voltages, checking her power supply unloaded, wondering why so many were not even close to what I was suppose to find according to the schematics, and perhaps giving up on her as having a good reason for not measuring up to par. Maybe just letting her try to perform her intended task is the way to go. Sure... you can check to see if voltages are near what they should be under load if you desire & if you find one off drastically at that point, go ahead & look deeper, but starting out to find some deep seeded reason for an end result is not practical, in MHO. Sort of akin to the old adage... if you don't look for no trouble, there won't be no trouble :-))))

Happy Gaming....

Wiring Your Pac Cabinet

by Bob Roberts

Chapter 1 - AC Wiring

After more than 5 years of trying I've decided that there just is not going to be a break in things that will afford me the needed time to completely doc the Pac-Man wiring in this old cab that has been taking up floor space here, so I am going to try & work on the project piecemeal :-(I'll probably get lost in the middle someplace, but I'm sure that someone will put me back on track. Hopefully, I'll be close enough to the end come Memorial Day, that I can finish it off.

Since the AC portion of the wiring...hmmm, well pretty near all of the wiring... will be the same for just about any vid game that you're tackling, I'm not going to hang the Pac sign on this section, but rather just AC wiring as it will plop right into other cabs as easily as it does in my demo Ms Pac cab.

First thing you need is your base to mount everything to, so let's start in the carpentry shop.



Cut a piece of 3/4" plywood scrap to a suitable size. I've cut this one to a 10" square... probably as small as you would want to go. I use to make them 12" square allowing more freedom when mounting with screw guns, but this scrap piece was handy & worked out fine.

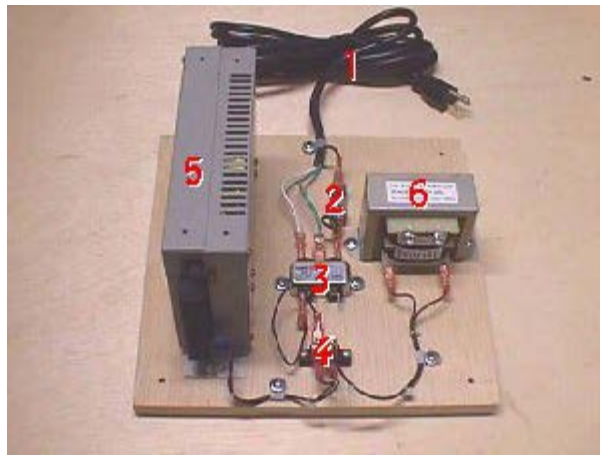


As a quick guide for the 4 outside corner holes for mounting in the cab I just took another small scrap piece & laid it vertically at each edge of the base & penciled in a short line marking the spots to drill an 1/8" hole. Simply stated... 3/4" from each edge.



I've mounted the needed components on the base above & did the preliminary wiring, rather than snapping pics after each component was mounted, & I'll just label or list from here. I have the components all facing the front for easy viewing. This was a convenience here in the flood capital since the base could be mounted vertically on the wall of the cab for protection from the rising waters. Actually, like the game bd itself, this "power center" can be mounted wherever there is enough room for it. I built 10 games with it mounted in the marquee area for one corner grocery store that got about 4 feet of water inside on several occasions ... just below the monitor inside the cab & did anyone unplug the games as the water was rising... no :-(

Note: Shielded isolation transformers had to be used to prevent monitor interference in the above case & in some mounted relatively high on the side walls. Of course, the shielded one is always needed in cocktail tables & counter top games where the close proximity causes monitor color impurities & pic weaving.

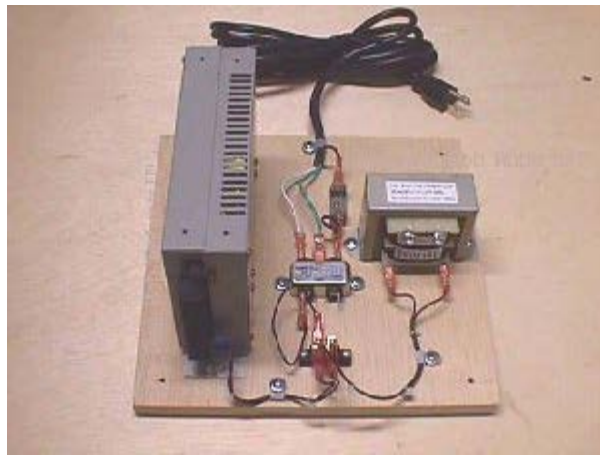


I guess a little nomenclature is in order to start...

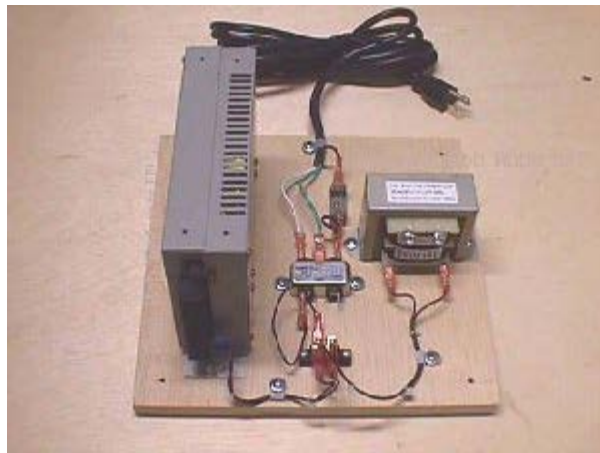
- **1** AC Line Cord AKA Power Cord
- **2** Fuse & Fuse Holder
- **3** AC Line Filter
- **4** AC Distribution Block
- **5** Switching Power Supply AKA Switcher
- **6** Isolation Transformer



Most of the components were mounted using the # 8 washerhead 1/2" screws. The exceptions would be the fuse holder & the AC distribution block which mount with # 6 pan head 1/2" philips screws. The pairs of wires are held together by ***cable ties*** & fastened to the base via ***cable clamps***. Note: Used in the pic above are 4" cable ties, 1/8" cable clamps on pairs and 1/4" to secure the line cord.



The **AC line cord** white wire goes directly to one terminal of the **AC line filter** & attaches via a .25 QD (quick disconnect) crimp-on terminal... AKA QC (quick connect) terminal in some circles. The green wire (earth ground) also goes directly to the center terminal on the **AC line filter**. The entrance side to the **AC line filter** will be the side that has the 3rd terminal in the center attached directly to the metal case & will be labeled "LINE". The exit will only have 2 terminals & be labeled as "LOAD". The final AC line cord wire, black, goes to the remaining terminal, but passes through the **fuse holder** first. Fuse holders are usually equipped with terminals that accept either the .187 QD or the .25 QD, although often times the .25 QD will have to be tightened up a bit with a pair of pliers for a tight connection.

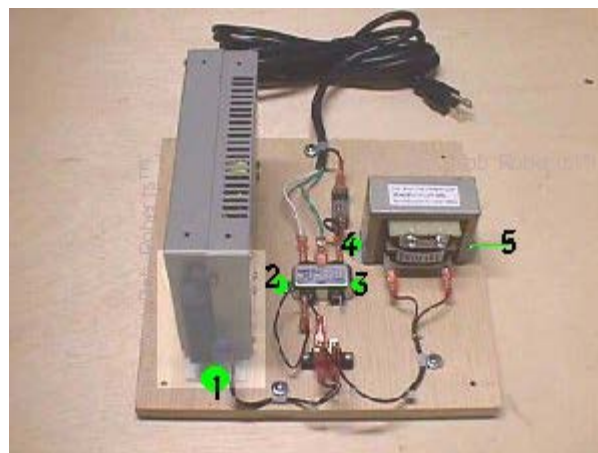


K... we have AC power in & filtered at this point. There are some blank terminals above & I'll cover them later so that I can offer alternate ways of wiring. For now, one side of the **AC line filter** connects directly to one terminal of the **AC distribution block** via a short 18 gauge jumper with a QD on each end. If a wire is added connecting the remaining **AC line filter** terminal to the remaining **AC distribution block** terminal... both empty in the pic... there would be 120 VAC input for distributing to the various components that require it, hence the name "distribution block".



In the closeup above of the *AC distribution block* terminals you can see how each pair of wires distributes the 120 volts. The 2 blank straight up terminals are used to power the marquee fluorescent fixture. I like to use a pair of blue 18 gauge wires for this, so that it is always easy to find them anyplace in the cab wiring harness.

K... before adding the missing wires & alternate wiring let me point out the earth ground path. Soooo many Qs have come up about earth ground... repeatedly over the years... that I really want to try to put it to sleep right here :-() Earth ground is just what it sounds like. A conductive pipe or rod is driven into the earth to a minimum depth of 8 feet at your electrical entry box giving you a true earth ground. Other sources of earth ground in your home would be conductive water pipes & cable TV ground... if it was properly installed. Telephone lines are earth grounded, as well, but they are usually parasitic & often attached to entry piping at your home's power meter box.



In the pic above we have earth ground which is carried via the green wire in the AC line cord from your wall outlet through the round middle prong on the plug, up to the middle terminal of your AC line filter. Remember, this terminal is the one that simply is a part of the metal case that houses the actual filter, hence we have the metal housing on your power entry point, your metal water pipes, the metal frame inside your TV set & etc, all hooked directly to your filter's metal case. We have "earth ground" present. Now... any metal in your cab that you want to earth ground can be done easily by simply making a loop to them to complete an electrical path (circuit). One piece of green 18 gauge wire connected from screw #2 to screw #1 will earth ground your switcher. A piece from screw #3 over to screw #4 will include

the isolation transformer in this earth ground circuit. Now a wire from screw #5 to your monitor frame or any other metal in your cab will include that piece in the earth ground circuit. Earth ground is earth ground no matter where you find it, so if you wanted to include a metal switch holder in your earth ground circuit you can run a wire from it to any one of the screws marked 1 thru 5 to include it... or even to another cab's metal as long as it was plugged in & properly earth grounded. Want to be earth grounded the hard way.... do your internal wiring & snap off the EG prong on your AC cord & run a wire from any number screw out the window, attach it to an 8 foot metal rod & drive it into the ground! You are earth grounded :-)



K... back to the topic at hand... the purpose of the blank terminals above. I said if a wire was added between the blank terminal on the line filter & the one on the AC distribution block we'd have a 120 volts to distribute to the various components that required it, but... you'd have power all the time that the line cord was plugged in. You'd have to unplug it from the wall to turn the game off, hence, this is where we are going to insert a switch to control the power. A lot of newbies get confused about this because of the rat's nest of wires that are usually found in older games, but it's really simple. You could put a switch right there on the base between the blank terminals... all we need to close the circuit & distribute the 120 VAC to it's destination... but then you'd need to get to the "power center" to turn the game off. Not much better than simply unplugging it from the wall, so what is needed is to move the switch to a convenient spot for turning the game off & on. Like Atari did when they moved their on/off switch to 6 inches off the floor & dead center on the back of the cab.... wait.... what were they thinking! That's why I put all on/off switches on the top right-hand side of the cab. At most... you only needed a chair to turn it off if you were vertically challenged.

All that is being done here is simply adding 2 wires to get to a remote place of convenience to control power to the game cab. Yes... you can switch both AC lines if you want. The jumper that was added to the first terminal of the AC filter going to the AC distribution block... toss it in file 13 & run a second pair of wires to your on/off switch... which will have to be DPST at least to interrupt both lines at the same time.



I said that the 2 blanks in the center of the AC distribution block were to feed the marquee fluorescent fixture, so that only leaves the 2 blanks on the isolation transformer... the secondary output which feeds the 120 VAC isolated to the monitor. K.... we have controllable AC power to everything now. Oh... one other thing in the switching, that comes up often... interlock switches. If we added 2 more switches into the main switch line in the cab, in series.. daisy chained... all switches would need to be closed in order to complete the circuit & have the game work. These added switches (interlock switches) are placed at the doors of the cab to automatically open up the circuit & shutdown the game when the door is opened. Most have an on position when pulled out in addition to the momentary position held in by the door, so you can repower it without replacing/closing the door.

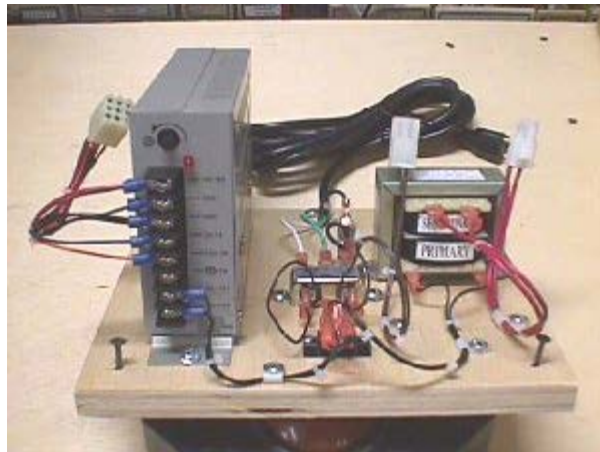
Time to add the missing wires to the soup!



Although it doesn't look like it in the pic, I use 18 gauge brown wires to go to the remote on/off switch helping to ID them in the harness the same way that blue for marquee power did. The brown wires of the switch line are terminated in a Molex .093 two position connector, but you can run them directly to the switch without a break plug.



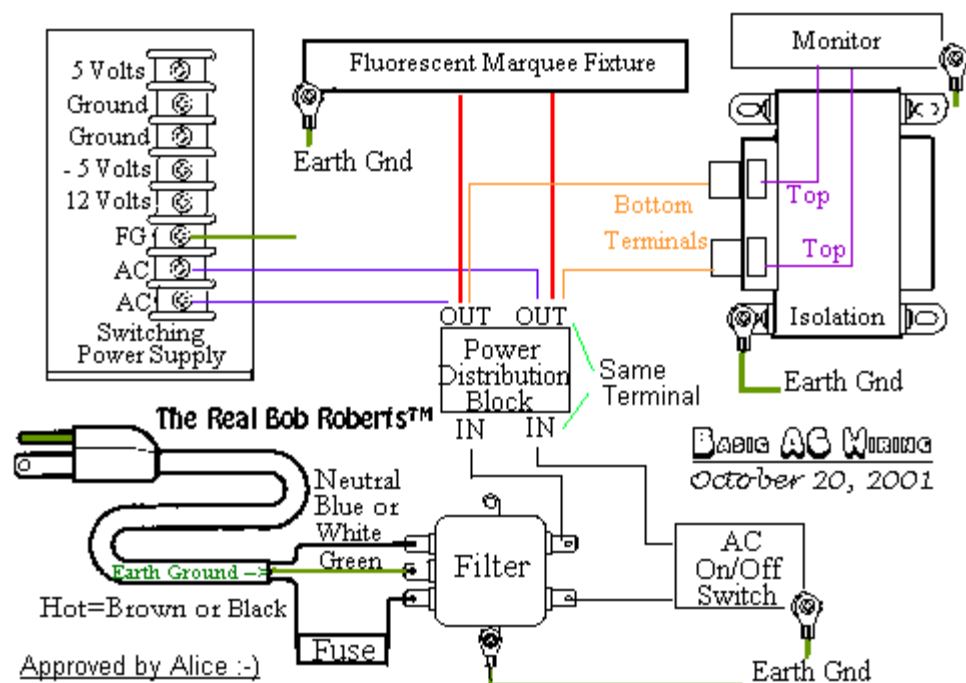
The red monitor wires above are terminated in the opposing halve of the Molex connector used for the switch line, so that the lines cannot be mistakenly crossed. As with the switch line, you can run straight to the monitor without this connector in line.



Completed & ready to set in the cab. Notice that a short DC harness has been added to the power supply using a 9 position .093 Molex connector. Positions 1, 2 & 3 are used for 5 volts. Positions 4, 5 & 6 are used for ground. Position 7 is used for - 5 volts & position 8 is used for 12 volts.

You do not need to add this Molex connector, either. The reason that I have break plugs in everything is because if you make more than one game & all the "power centers" are made the same way, it is easy to do a quick swap out to get a game going in a hurry or simply for t-shooting purposes. If you suspect you have a trouble with power a quick change to a known good one will answer your Qs & if there is a problem with the one removed, you can work on it at a work station instead of hanging upside down in the cab trying to figure out what is wrong.

Incidentally, did this "power center" look familiar to you? Perhaps you've seen it another way on my site? Hmmmm....



[Next Chapter... Into The Cabinet ...](#)

Happy Gaming...

Acronyms, Abbreviations & Terms

Amp	Amperes
AC	Alternating Current
Axial Leads	Leads in & out of component ends on same axis
BD	Board (Circuit)
BTW	By The Way
B&W	Black & White
CG	Computer Grade
Cap	Capacitor
Chassis	Monitor PCB
Chassis Pan	Part of monitor frame that chassis bolts to
CMOS	Complementary Metal Oxide Semiconductor
CP	Control Panel
CPO	Control Panel Overlay
CPU	Central Processing Unit
CRT	Cathode Ray Tube
CS	Composite Sync
DAC	Digital to Analog Converter
DBV	Dollar Bill Validator
DC	Direct Current
DMM	Digital MultiMeter
DPDT	Double Pole Double Throw
DPST	Double Pole Single Throw
EPROM	Erasable Programmable Read Only Memory
FBT	FlyBack Transformer
FET	Field Effect Transistor
FRB	Flat Rate Box
GND	GrouND
GROT	General Rule Of Thumb
HOT	Horizontal Output Transistor
HS	Horizontal Sync
IC	Intergrated Circuit
ID	IDentification
IMHO	In My Humble Opinion
JAMMA	Japanese Amusement Machine Manufacturers Association
LMK	Let Me Know
LYK	Let You Know
mA	Milliamperes
Med Res	Medium Resolution (Mid Res)

MFD	Micofarads
MPU	Main Processing Unit
NiCad	Nickel Cadium
NOS	New Old Stock
NPN	Transistor with N-type emitter & collector & P-type base
NS	NanoSecond
NTSC	National Television Systems Committee
OEM	Original Equipment Manufacturer
OTP	One Time Programmable
PCB	Printed Circuit Board
PNP	Transistor with P-type emitter & collector & N-type base
PnP	Plug and Play
Pot	Potentiometer
PWR	PoWeR
PROM	Programmable Read Only Memory
PS	Power Supply
QC	Quick Connect
QD	Quick Disconnect
Radial Leads	Both leads in & out the same end of a component
RAM	Random Access Memory
RGB	Red-Green-Blue
ROM	Read Only Memory
ROT	Rule Of Thumb
SCR	Silicon Controlled Rectifier
SIP	Single In-line Package
SM	Surface Mount
Std Res	Standard Resolution (Low Res)
Sync	Synchronization
TB	TrackBall
uF	Micofarads
Universal Mount	Monitor framework that can mount in multiple positions
VAC	Volts Alternating Current
VDC	Volts Direct Current
VR	Voltage Regulator
VS	Vertical Sync
WV	Working Volts
Xformer	Transformer
Xceiver	Transceiver
Xsistor	Transistor
Xmitter	Transmitter
Xtal	Crystal
Yoke	Conic wire coils mounted on CRT neck
ZIF	Zero Insertion Force

Got one you don't know & it's not here... LMK... I'll add it for you.

Atari Audio/Regulator Board Notes

by Bob Roberts

So many newbies entering the hobby this year with Atari games that I thought it was time to post something on using the kits for repairing the A/R boards to help avoid all the pitfalls. I'll try to cover all the Qs that have come up over the years.

Starting with the Asteroids A/R bd which used 1000uf caps for C9 & C10 where all post versions used 3300uf even though many of the schematics & part lists called out for the 1000ufs, the actual bd shipped in the cab had the 3300ufs installed. The kits contain the 3300uf caps which are universal & once installed in the A/R -01 it can be used anywhere you find an A/R or an A/R II-01. But for the physical size the A/R II-01 can be used in place of an A/R bd & that prompted many an op to saw the unused portion of the A/R II-01 bd completely off to accommodate their Asteroids or Football games. Some even cut down the A/R II-02 which can be used in place of any of the A/R or A/R II-xx versions.

The A/R II-02 kit covers all versions of the bds with parts leftover. So many people ordered the wrong kits when we had separate ones for each version of the A/R II-xx bds that we cutback to just the -02 kit for all... and for that matter, it will cover the A/R bds, too, although you have all the unneeded parts for the blank side leftover.

My [Cap Map](#) on these is often missed, so I'll put a link here. It lists many of my notes right on it, but I'll add them in here, as well. You can see from the Cap Map which parts are in the kit. To keep the cost to a minimum only the components that typically fail are included. The LM305 on these bds has been time proven, although there have been a few cases of failure, so it is not included nor are the TDA2002 amps which seem to be rock solid in this app. The 5 volt adjustment pot is not included along with the connectors & small passive components... all available on the Parts Page if you see that they are toast on your bd.

I guess the most helpful way to cover the common mistakes is to just make a do list of each component with notes.

1 Capacitors

- This is basically for the newbies... caps are marked as to their positive & negative leads & they must be adhered to with the + (positive) & - (negative) symbols on the bd or as pic'd on the [Cap Map](#).

2 Q1 LM305 Regulator

- This part is not in the kit & it requires a steady hand and a good eye to align all eight legs for installation if need be & there is a tab marker on the case signifying the number 8 leg.
- Do not overheat when soldering. Tack solder around the circle once & then repeat for final solder allowing each joint time to cool.

3 Q2 2N6107/TIP32

- TO220 Insulator must be used.
- Nylon 6-32 Machine Screw must be used.
- Do not overtighten screw.

- Be sure there is no short between the mounting tab & the heat sink.

4 Q3 2N3055

- Insulator must be used.
- Metal machine screw must be used.
- Case must be isolated from the heat sink.
- It is important to tighten the mounting screws snugly to complete the connection between the case (collector) and the trace below. Only one screw actually completes the circuit and for added stability you can connect a wire with a ring terminal to the second screw & solder the other end to the trace. You can also sand/file/brush the head of the main screw to solder it directly to the trace after it is mounted. The TO3 case is tank solid & not prone to damage from overtightening the mounting screws. As with any TO3 xistor you always want to mount it before doing any soldering.
- Always finish up this job by checking to make sure there is no short between the case & the heat sink.

5 Q5 TDA2002 Audio Amplifier

- Not part of kit... take care not to overheat when soldering if you replace it.
- No insulator.
- Metal screw.

6 Q7 TDA2002 Audio Amplifier

- Not part of kit... take care not to overheat when soldering if you replace it.
- No insulator.
- Metal screw.

7 Q8 7812 12 Volt Regulator

- No insulator.
- Metal screw.
- Tighten to hold in place, but do not overtighten. Overtightening of TO220 xistors when a metal screw is used can damage internal device connections. Take care not to slip with tool & jab the plastic body which can have the same damage results.

8 Q9 7905 -5 Volt Regulator

- TO220 Insulator must be used.
- Nylon 6-32 Machine Screw must be used.
- Do not overtighten screw. Overtightening of nylon screws will strip the threads, so tighten just till the screw snugs up.
- Unloaded output -15 volts. Many Atari games do not use the -5 volts even though their manual and/or schematic may show it & hence an unloaded -15 volts at the test point even when the game bd is in use. Pin 9 of P10 connector is the -5 volt output & many game harnesses don't even have a wire in this position.

Happy Gaming...

Atari A/R Board Burnt R29/R30 Quick Fix

by Bob Roberts

I have the pic below linked to the A/RII-02 kit on the Parts Page, but lately many of you have been asking for more details citing an inability to read/trace schematics. This prompted me to write up this simple little quick fix shotgun note.



R29 & R30 are 10 ohm differential resistors for the sense lines. Often times the pins in the game edge connector that correspond to these sense lines make poor contact to the PCB causing the added current draw to char one of these. Most times the resistor is still good but, for aesthetic value, a 10 ohm resistor is included in the A/R repair kits. You should clean & tighten, or replace, the offending pin in the edge connector, as well.

Parts You'll Need:

From the [Dollar Store](#)

Item DS180 Pack of Split Pins - \$1.00

From the [Parts Page](#)

1 - Pack 10 ohm 1/2 watt resistors 4 for - \$1.00

Tools You'll Need:

You'll need the [HT-1921 crimping tool](#) or a compatible crimper, not a \$2 or \$3 automotive crimper that is fine for most fully insulated quick disconnects, but does not have the saddles to do small pins & sockets. You'll need a split pin extractor or any of the common simple items I have listed on the [Crimp Mystery Page](#) and, of course, a [flushcutter](#) of some kind.

Getting Started:

The first thing to do is replace the 2 resistors at R29 & R30 being sure to clean up the PCB, if charred, under them before installing the new ones.

Next pull your 22/44 edge connector from the game PCB. At this point it would be a good idea to use a magnifying glass to check for the word "Molex" on the end of the black housing to be sure that it has not been previously changed out with an off-brand connector. Now that you know you have the Molex you can use that magnifying glass to locate the position numbers on the housing.... noting that all numerals are on the insertion side (wire side)... and find positions 1/A/2/B & 21/22. These are the pins that you'll need to shotgun & the foolproof way is to remove one wire at a time, cut the old pin off about a 1/4" back giving you a good clean wire to attach a new pin to & then replace it in the same position on the housing. Do them all like that & it'll squash the error margin.

You should be good to go at this point, but you should clean the edge fingers on the PCB with an eraser before replacing the 22/44 edge connector. There are a couple caveats... one being that if you do not do a good job in crimping, keeping a tight, rounded crimp it may not fit into the housing slot. If this happens you can use the crimper again to reshape allowing entry. You want your finish crimp to look as close as possible to the old one that you clipped off. A fair to good job will fall right into the slot easily. Also, when using an eraser be sure that all residue is brushed or blown away from the board & connector.... rubber is an insulator!

If you have more than one A/R board in your game, such as Pole Position, you may need to double up on the split pin purchase as it will take a few more. The Pole Position second board's 15/30 connector will need these positions shotgunned... 1/A/2/B & 14/15.

Happy Gaming...

- Atari's Big Blue -

Big Blue is the huge 2" in diameter blue capacitor mounted in the transformer assembly in the bottom of Atari cabinets. Since most are about 20 years old at this point in time, they have a much higher failure rate now... not that they haven't failed prior to this date... and they create a wide range of problems & should be changed. Symptoms range from not powering up at all to randomly powering up.

Update 2/03: I read in a great deal of emails about Atari woes, that should be corrected by a new Big Blue, that it couldn't be the trouble because they had recently replaced it... sometimes only a few weeks prior. Many hours of wasted time t-shooting later they discover that the Big Blue was at fault. Inevitably, the next Q is could there be something else wrong that is causing it to die. What is happening in these cases is that they are buying surplus CG caps & they are most often as old, if not older, than the one in the game already & destined to fail prematurely. Often times the value is erroneously thought to be the cause, but any value from 26,000uf to 32,000uf should work fine. I chose to have mine made in a 27,000uf value as I think that to be the best filter for those supplies, but I have used all other sizes in that range, before finding a mfr willing to remake those, without any repercussions.

Incidentally, I chose a black wrap to be able to distinguish them from the old OEM "Big Blue". Big Blue is the name that I dubbed them with back in 1979, admittedly having IBM on my mind at that time & all the various Atari labels being blue. After coining the term "Big Blue", which incidentally I had printed right on my labels, it seems that many people all these years later seem to use it to describe a CG filter capacitor on anything... kind of defeating the purpose I had for the term. I get emails with phases like, "I need an MCR Big Blue", a "Tron Big Blue", a "Gottlieb Big Blue" and so on & so forth. Most times you can kind of figure out just what was needed, but sometimes there are multiple filters or a usage that is unfamiliar that may cause errors.

"Big Blue" : The term used for any of the large blue filter capacitors in classic Atari arcade games in the AC power supply located in the bottom of the cab with an OEM range of 26kuf15v to 28kuf15v.

Update 2/06: Three years later & I still hear the same thing over & over. My problem can't be the Big Blue because I just bought a new one 3 months ago! I know that surplus Big Blues are awful tempting with their prices running from \$1.50 to \$5.00 each, but they simply do not last in most cases. Manufacturing caps is not my game, so I turned to the net to see what I could find out about this & here are a few things that I found out about that I had no clue about...

Shelf life depends on the control of temperature and humidity... which should be kept as low as possible... during storage. Most mfr's recommended retesting after 5 years on the shelf. I found one that really surprised me, stating, "Even under ideal storage conditions capacitance decreases with the passage of time and therefore should be used within 6 months of delivery date to insure 100% usability. After 9 months a noticeable deterioration will begin." In one military doc I read that stored electrolytics needed to be lab tested after a 5 year shelf period & if they pass, retested periodically and in any event, disposed of as hazardous waste material at age 10.

Most of the Big Blues or other high value, low voltage CG caps found in the surplus electronic stores around the country are from 16 years old to 36 years old, so they are closer to dead than they are to life, albeit from sitting around unused. Personally, I'd rather go with the new fresh cap & be done with it over changing out with surplus over & over trying to save a buck. My guess is that over time the expense of a new cap will work out to a much better deal.

Certainly 100's, if not 1000's, of dead Atari games have been resurrected solely by replacing the Big Blue & I've heard stories of some even found by the roadside waiting for the Grim Reaper to carry them off!

Many problems blamed on the monitor are actually a result of this cap being weak or bad.

Here are 5 Big Blue Symptoms that are erroneously blamed on the monitor.

- 1 Intermittent lightning streaks in pic/hum bars/weaving.
- 2 Blank raster... steady or intermittent.
- 3 Jumpy pic sometimes described as jiggles.

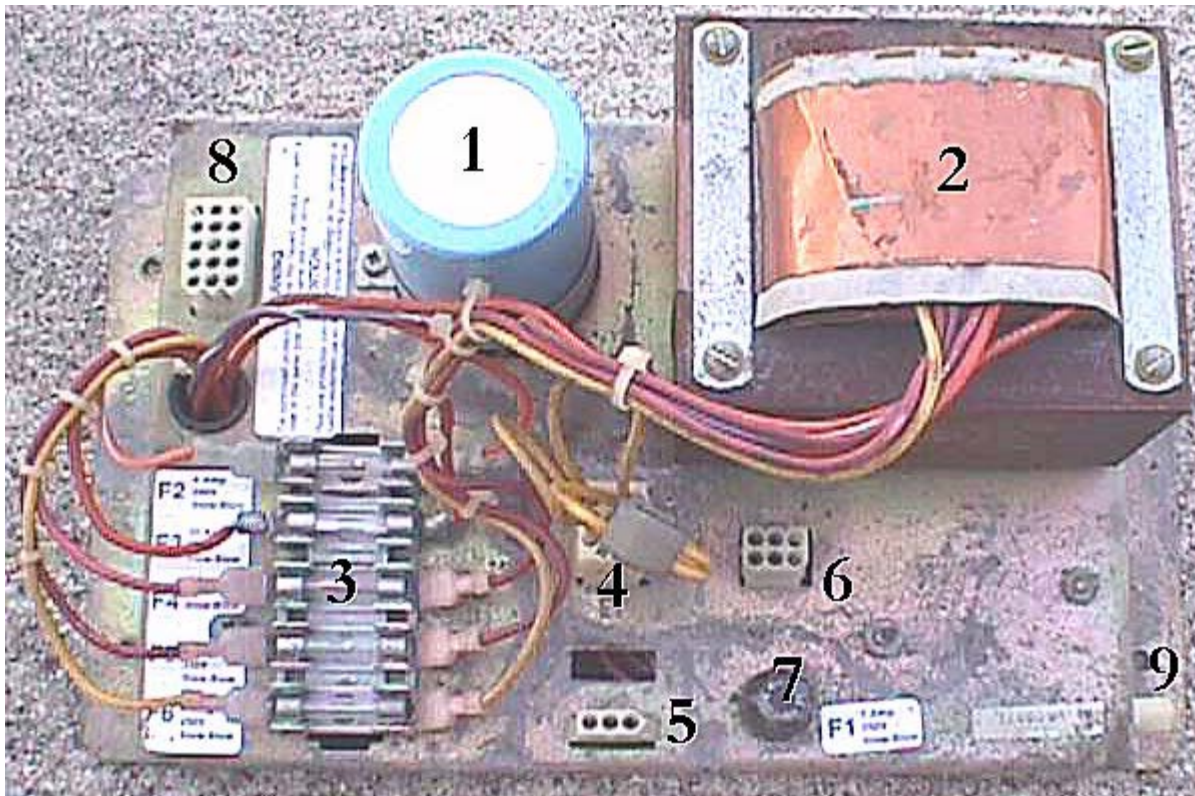
- 4 Failure of H hold to lock in.
- 5 Intermittent vertical roll or failure to lock in.

Note: The symptoms above are only the ones that mimic a monitor failure problem, but a bad Big Blue will manifest many other symptoms from the game being totally dead to the start LEDs flashing to a loud audible hum & more. Make sure you have a known good BB in place before you go tearing down a game hunting a problem that it is responsible for.

Atari AC Power Supply Notes

by Bob Roberts

One of the guys recently ran into a bit of trouble in overhauling his Atari AC power supply, so I thought this would be an easy enough page to cover a lot of general questions about them. I'm going to grab one of them & try to break it down into generalized answers, including what parts I have that can be used. There are quite a few variations, so you should use this only as a guide in conjunction with the specifics in the game manual for your particular game.



1 Filter Cap "Big Blue"

- Filters the 10.6 VDC Output To The A/R Board
- Polarity Must Be Followed When Wiring
- More Information Can Be Found [Here](#).
- New In Stock Big Blues Always Available At \$12.50 Each On The [Parts Page](#)

2 Shielded Transformer

- Copper Shielded
- AC In With Multiple Outputs

3 5 Position Fuse Block

- Pic'd - Less Desired Snap Off Version
- [Better Solid Base](#)
- Both In Stock At \$5 & \$6

3A How To Use The Generic Atari Fuse Kit Available At \$4.00

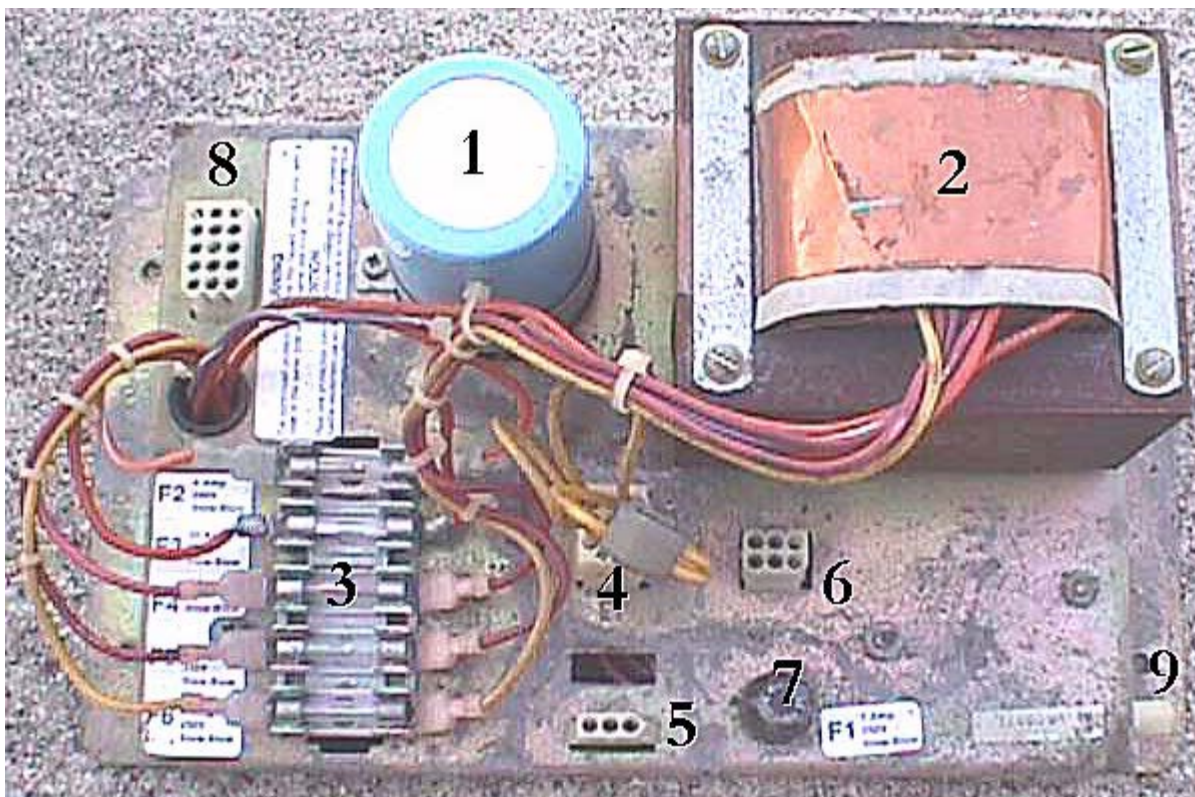
- F1 - Main - 7A Slow Blow (7)
- F2 - 10.6VDC - 4A Slow Blow
- F3 - Bridge Rectifier Input - 20A or 25A Slow Blow
- F4 - A/R Bd Bridge Feed - 4A Slow Blow
- F5 - A/R Bd Bridge Feed - 4A Slow Blow
- F6 - 6.1VAC Coin Door Lamps - 3A Slow Blow

Notes:

F1 European 220/240VAC Models Use 4ASB 250V

F3 25ASB Used In Models Ending With -04,-05 & -06

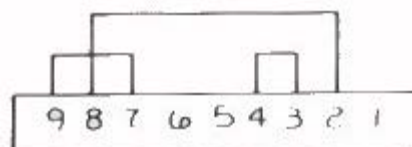
F6 Is Listed As 4ASB (Overfused) And 3ASB Is Sufficient All Models



4 Voltage Selection Block

- Violet Jumper For 100VAC Input
- Pic'd - Yellow Jumper For 120VAC Input
- Gray Jumper For 200VAC Input

- Blue Jumper For 220VAC Input

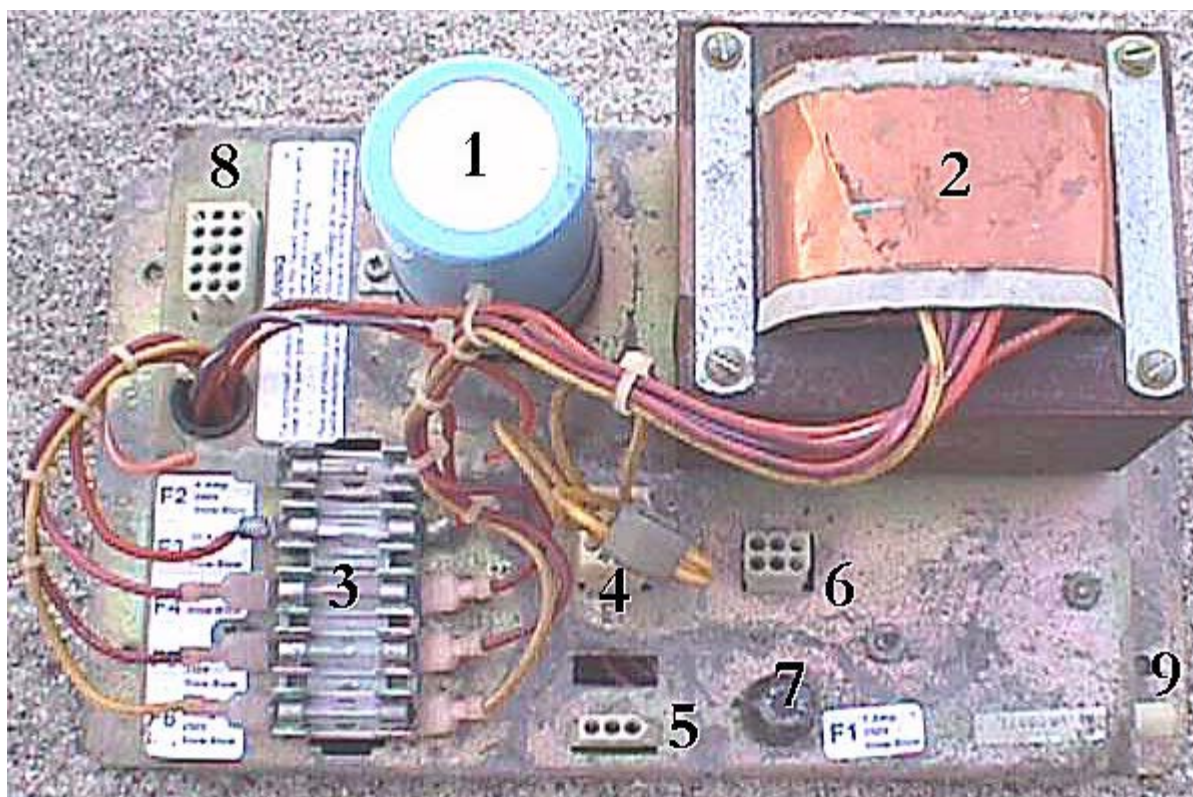


- Brown Jumper For 240VAC Input



Notes:

You Can Make Your Own Jumper With A 9 Position Molex .093 Connector Found On The [Connector Page](#) Using The Same Color Code As Used By Atari If Yours Is Missing... You Must Have The Correct Jumper Installed In Order For It To Work!



5 110VAC Supply For Fluorescent Fixture

- Mates With 3 Position Molex .093 Connector On The [Connector Page](#)

6 On/Off & Interlock Switches

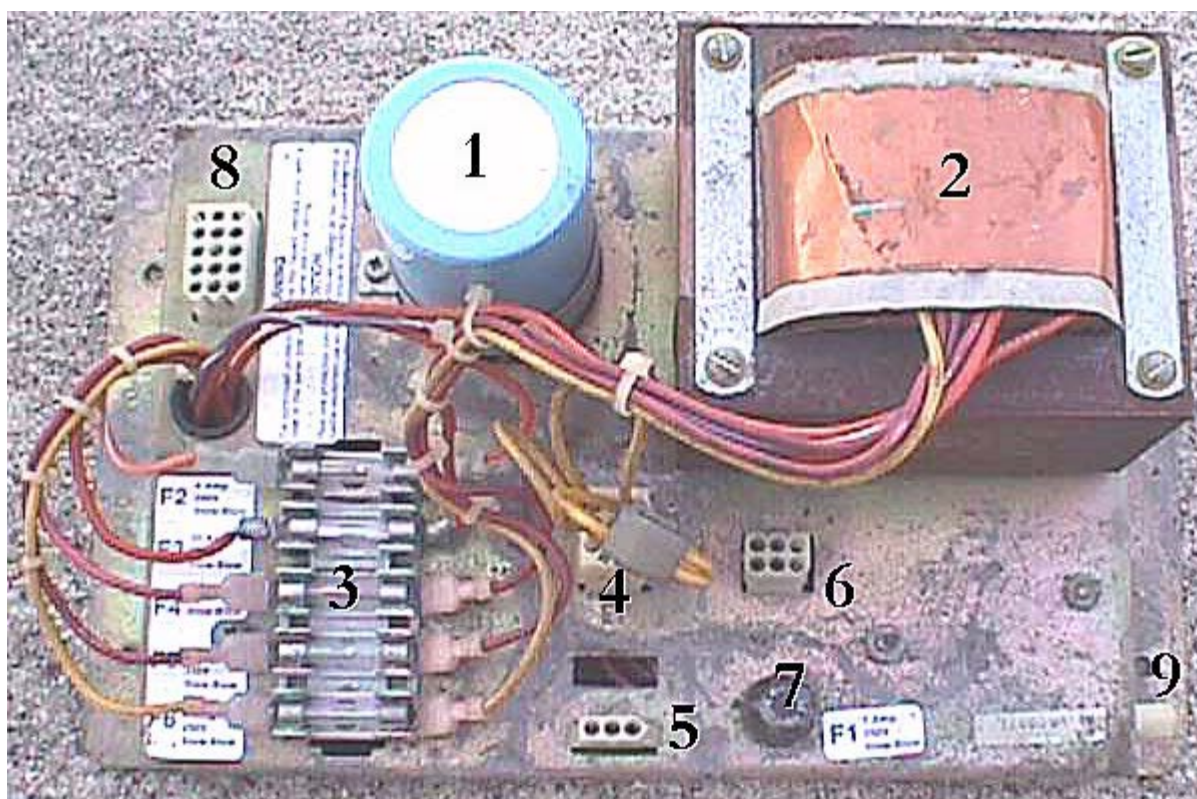
- Controls AC Power In Thru-out Game
- All Interlocks & On/Off Switch Must Be Closed For Game To Power Up

Note:

You Can Make A Jumper Plug With A [Molex 6 Position .093 Connector](#) Jumping Pins 1 & 4 Together & Pins 2 & 5 Together To Bypass All Cabinet Switches & Wiring Thereby Eliminating Them As A Source Of trouble With Your Game. This Will Allow You To Use A Power Block On The Work Bench, As Well.

7 Main Line Fuse

- 7ASB USA or 4ASB European

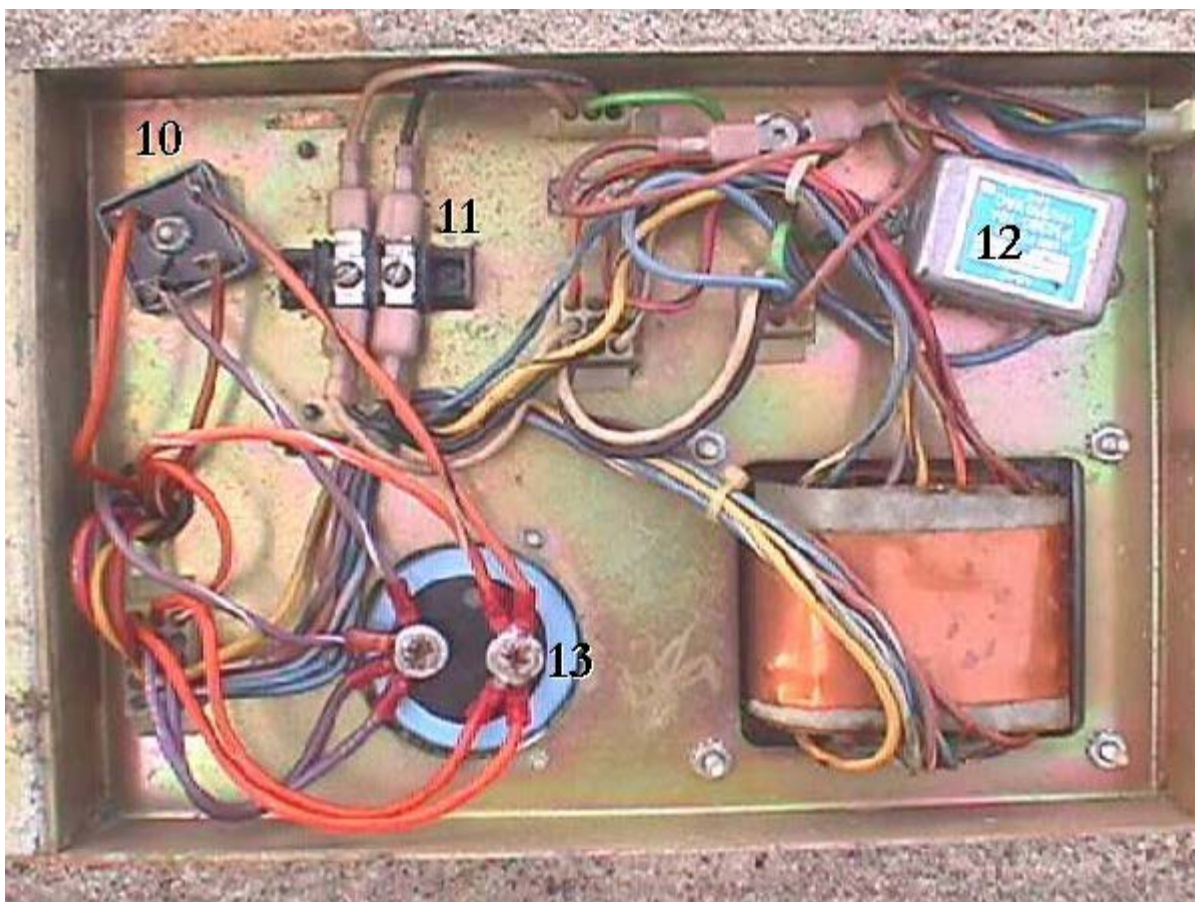


8 AC/DC Power Out

- Pin 1 - 10.3VDC To Coin Door & PCB
- Pin 2 - 10.3VDC To Audio/Regulator Board
- Pin 3 - 10.3VDC To Audio/Regulator Board
- Pin 4 - Ground To Audio/Regulator Board
- Pin 5 - Ground To Audio/Regulator Board
- Pin 8 - 6.3VAC To Coin Door Lamps
- Pin 9 - 6.3VAC To Coin Door Lamps
- Pin 12 - Jumper To Pin 13
- Pin 13 - Jumper To Pin 12
- Pin 10 - 120VAC Isolated To Monitor
- Pin 15 - 120VAC Isolated To Monitor
- Mates With 15 Position Molex .093 Connector On The [Connector Page](#)

9 AC Power Entry

- Where You Plug Your AC Line Cord From The Wall Outlet!
- Mates With 3 Position Molex .093 Connector On The [Connector Page](#)



10 Bridge Rectifier

- Shipped With A MDA 3501 (35Amp 100 Volt) Or Equivalent
- Best Replaced With A [MDA 3502](#) (35Amp 200 Volt) Or Equivalent
- POLARITY Must Be Followed!
- More On [Polarity](#)

11 Distribution Block

- The Distribution Block On The [Parts Page](#) Is Slightly Smaller, But Can Be Used As A Replacement By Drilling One Hole For Mounting If Yours Is Broken.

12 AC Line Filter

- The AC Line Filter On The [Parts Page](#) Is A Drop In Replacement For This One.

13 Big Blue + Terminal

- All Orange Wires Connect To This + Terminal Which Is Clearly Marked With The + On The Bottom Of The Capacitor
- The + Terminal Orange Wire Going To The Bridge Also Connects To The + Terminal Of The Bridge
- All Violet Wires Connect To The - Terminal Of Big Blue
- The - Terminal Violet Wire Going To The Bridge Also Connects To The - Terminal Of The Bridge
- The Two Remaining Bridge Terminals Diagonally Across From Each Other Are The AC Inputs For The Bridge... No Polarity To Them

Well... it has been many weeks since I started this one, but I think I finally have it finished in

about 20 sessions of time squeezed out of 20 hour days. At this point, about the only other thing I can think of to add to this is... that they make one heck of a good boat anchor if all else fails!

Happy Gaming...

Classic Atari Volume Control

by Bob Roberts

The Atari volume pot has generated many an email over the years & for the past year it has been working steadily towards the top ten of all time. The number one question among them is, "Can I use one of the \$1 to \$2 pots on your Pot Page in place of the Atari pot?". Then following up with do you stock it... why don't you stock it... where can I get it... why is it sooooo costly... why don't other games need this expensive pot & so on & so forth.



Let's start with the easy one of why we don't stock this or any of the specialized pots for steering, throttles & etc. It's simply the cost of them averaging \$25 apiece you can tie up a bundle of money in a hurry if you try to stock all of them & it's a long term investment best left to the big companies.

Can you use a \$1/\$2 pot in place of it?

No! Trimmer pots like that typically are from 1/8 watt to 3/4 watt & will not handle that output. How about a volume pot like the ones William's uses? No... even the 1 & 2 watt pots are not good enough for this circuit. The Atari pot is 12.5 watts & the reason that you need a beefy one like that is because it is tied directly to the amplified audio output rather than a part of the preamp circuit.

As I remember, most of the game titles shipped without a knob on the shaft... there may have been 1 or 2 that shipped with knobs, but I can't be certain. In any event, once the pots had been on the streets a while here in our climate they would sometimes bind up in one position & trying to turn the shaft by hand was futile. Your fingers would just slip prompting some techs to pull out their pliers... often times ruining the pot. After I ran into a few of the broken ones I ordered in the black knobs as pic'd above. They helped to keep them free by rocking them back & forth fast, periodically. This always kept the wiper free, as well as, cleaning the contact surface.

Due to the many requests we have decided to keep a few of these on hand for your convenience. They are listed on the [Parts Page](#) at \$25. We also have some of the knobs left at

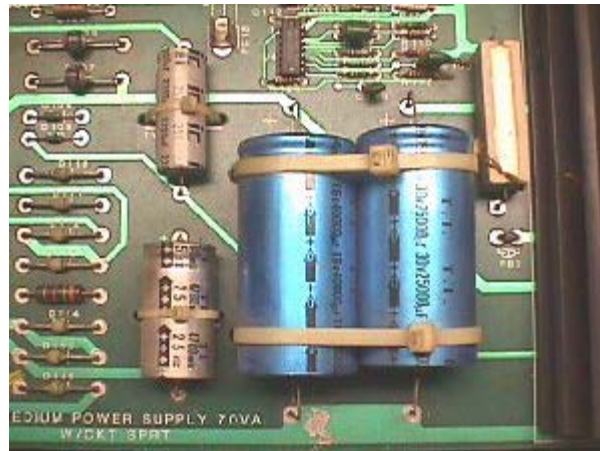
\$4 each if needed.

Happy Gaming...

Replacing Obsolete Caps

by Bob Roberts

I have several different methods of changing out the older axial capacitors posted in various places onsite, but here's another method of using them on an A082-90421-xxxx Midway medium power supply board done in the wee hours of the morning to keep a promise to John V.



The actual setup I'm doing is a not-so-pretty configuration, but it shows the basic principles involved electrically. Once you grasp that concept you can see how you could arrange the new caps many different ways on the board so long as you wire them them up correctly. K... let's change out this 40K & 25K axials using three new 22K radials.



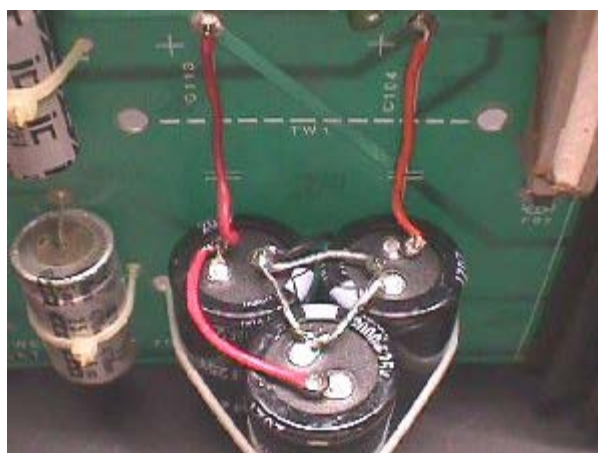
The first step was to set the three in a triangular configuration on the bench with all the ground legs facing the center. Then a piece of black 18ga wire approximately 12" long was stripped & tinned on one end about 3 inches. Starting at any one of the 3 ground legs it can be soldered on in the same triangular configuration tying all three together to serve as a ground terminal for all while stabilizing the stack on one end.



Now the stack can be placed on the board & fastened in place with a 12" cable tie making sure that the insulated part of the new ground terminal wire is placed at the bottom where it can be soldered to either one of the 2 ground tie points left after removing the originals.



Next step is to tie in the positive legs. The one on the left was a single 40K so a piece of red 18ga wire was soldered onto the top capacitor + terminal & then looped to the lower cap + terminal & finally over to the + tie point on the board. This combines the 2 capacitors in parallel to form a new 44K filter cap. On the right you simply have to tie the remaining cap's + terminal to the + tie point on the board's right side to tie in a 22K fresh replacement which is more than adequate to replace the existing 25K.



You can add hot glue to stabilize if needed, or desired, and as I said in the beginning, as long as you maintain the electrical circuit you can place these caps in a number of

other arrangements & they wouldn't necessarily have to be stacked, e.g., the 2 combined ones could lay flat to the bd where they are now, while the single cap could be placed above it flat to the board.

There is no limit to the ways this can be accomplished as long as the electrical integrity is not compromised. Caps can be hot glued on end any place on the bd where there is room for them & wires run to the appropriate tie points on the bd... which do not necessarily have to be where the old ones were since you can follow along the bd trace to a more convenient spot to tie into. For that matter, you are not restricted to using the board at all. If you find there is no room for a replacement cap you can mount it remotely... bottom of the cab...side...if ugly is your thing you can mount it on top of the cab if you want, so long as you run wires to their respective tie points on the PCB they will still function the same.

Happy Gaming...

Replacing B+ Filters

Here are links to specific monitors changing out the archaic huge capacitors of yesteryear with the new modern smaller capacitors that do not require as much real estate.

[Electrohome G05](#)

[Electrohome G07](#)

[Sanyo 20EZ](#)

[Wells-Gardner K4900](#)

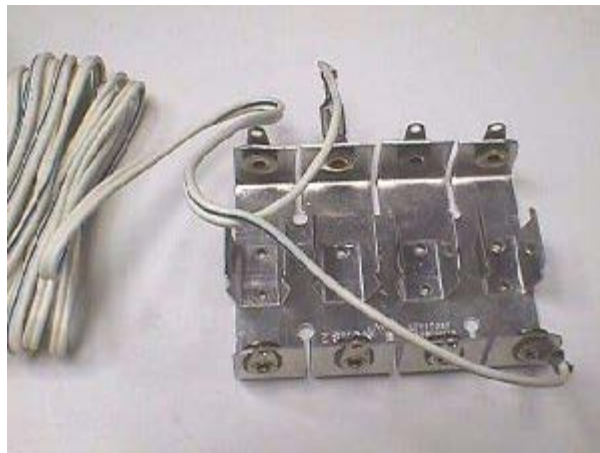
Remote Battery Holder

by Bob Roberts

There are many people still using AA batteries mounted off board for memory backup, especially on the older pinball machines, and it appears that there is a segment of hobbyist that have had problems in doing this, so I thought I would layout one way using a couple items off the Dollar Store Page. The first would be DS109, the heavy duty aluminum holder pic'd below.



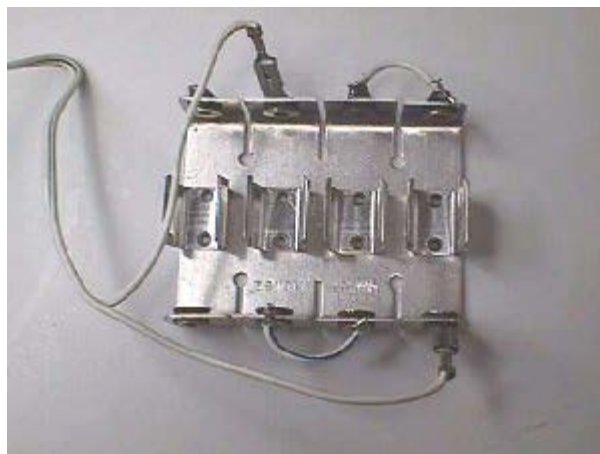
Then using the item DS128, a hank of speaker wire, you can relocate your batteries to a suitable off-board location.



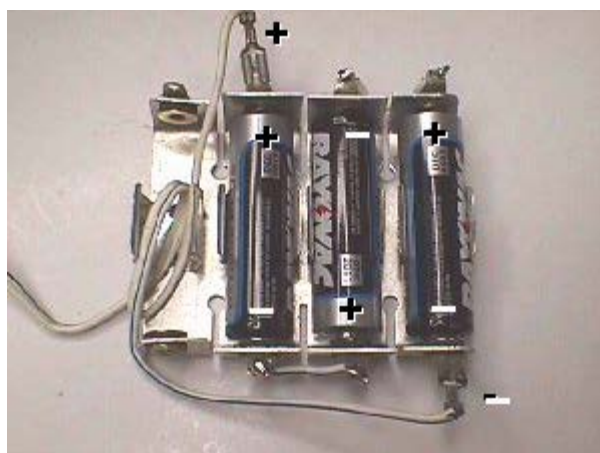
The married speaker wire has one lead striped making it easy to polarize by using it as the ground wire & the solid white wire as the positive lead. There are .187 QDs on one end making it as easy to hook up to the holder.



Cut a piece off the other end of the speaker wire about an inch long & separate, strip & tin the ends. Use these to jumper the holders into a series configuration.



The striped wire entering on the bottom corner will be your negative, or ground side, and the positive end of the first battery is jumpered over to the negative end of battery two. The positive end of battery two is jumpered over to the negative end of battery three. Now the positive side leaves from the positive end of battery three to go to your remote positive terminal of your PCB or whatever project. You only need to use three sections of the holder since 1.5 volt batteries daisy chained in this fashion... 3 x 1.5v ... will give you 4.5 volts combined output... more than enough to ensure memory backup.



Once you have this together you can mount it in a convenient spot using small screws or double sided adhesive tape. Run the wire back to where you need it & cut off the

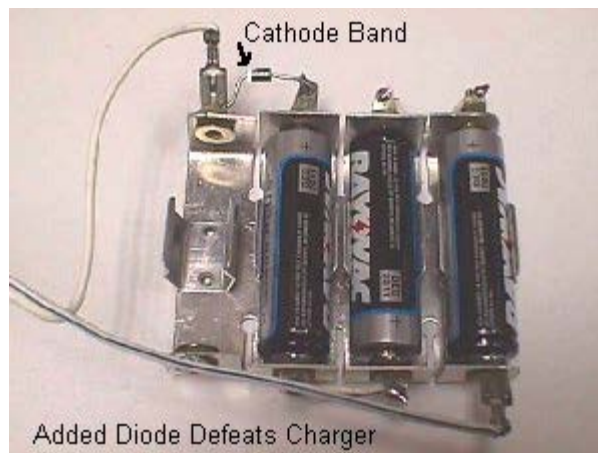
excess.



Going a step further, you can add an inline break using a 2 position Molex connector. Just be sure to carry through the correct polarity... stripe wire in, stripe wire out.

This is not necessarily my idea of the best way to retain memory, but it is a cheap enough way.

Note: If you are using this to replace a ni-cad battery you have to install a blocking diode in-line to defeat the charger system. In fact, let me put another pic here with the charger defeated.



Happy Gaming...

JAMMA HARNESS CONNECTIONS For BLOODSTORM

WIRE COLOR	COMPONENT SIDE	
Black	GND	A
Black	GND	B
Red	+5 vdc	C
Red	+5 vdc	D
		E
Orange	+12 vdc	F
KEY		H
Blue-Green	Ticket Count	J
		K
Yellow-Green	Left Speaker (-)	L
White-Green	Right Speaker (-)	M
Green-Black	Video Green	N
White	Video Sync	P
Orange-Black	Service	R
		S
Green-Blue	Coin 2	T
Red-Yellow	Start 2	U
Green-Yellow	Player 2 - Up	V
Blue-Yellow	Player 2 - Down	W
Black-Yellow	Player 2 - Left	X
Violet-Yellow	Player 2 - Right	Y
Brown-Yellow	Player 2 - Back Arm	Z
White-Yellow	Player 2 - Block	a
Orange-Yellow	Player 2 - Front Arm	b
Grey-Yellow	Player 2 - Back Leg	c
Yellow-Black	Player 2 - Front Leg	d
Black	GND	e
Black	GND	f

	SOLDER SIDE	WIRE COLOR
1	GND	Black
2	GND	Black
3	+5 vdc	Red
4	+5 vdc	Red
5		
6	+12 vdc	Orange
7	KEY	
8	Coin Counter	Red-Green
9		
10	Left Speaker (+)	Yellow-Red
11	Right Speaker (+)	White-Red
12	Video Red	Red-Black
13	Video Blue	Blue-Black
14	Video GND	White-Black
15	Test	Blue
16	Coin 1	Red-Blue
17	Start 1	Red-White
18	Player 1 - Up	Green-White
19	Player 1 - Down	Blue-White
20	Player 1 - Left	Black-White
21	Player 1 - Right	Violet-White
22	Player 1 - Back Arm	Brown-White
23	Player 1 - Block	Yellow-White
24	Player 1 - Front Arm	Orange White
25	Player 1 - Back Leg	Grey-White
26	Player 1 - Front Leg	Yellow-Orange
27	GND	Black
28	GND	Black

DIP SWITCH SETTINGS for BLOODSTORM

ON	
1	Test Mode Normal
2	Violence ON
3	Screen Upright
4	negative Video Sync (-)

OFF	
Strata Test Mode	1
Violence OFF	2
Screen Flip	3
positive Video Sync (+)	4

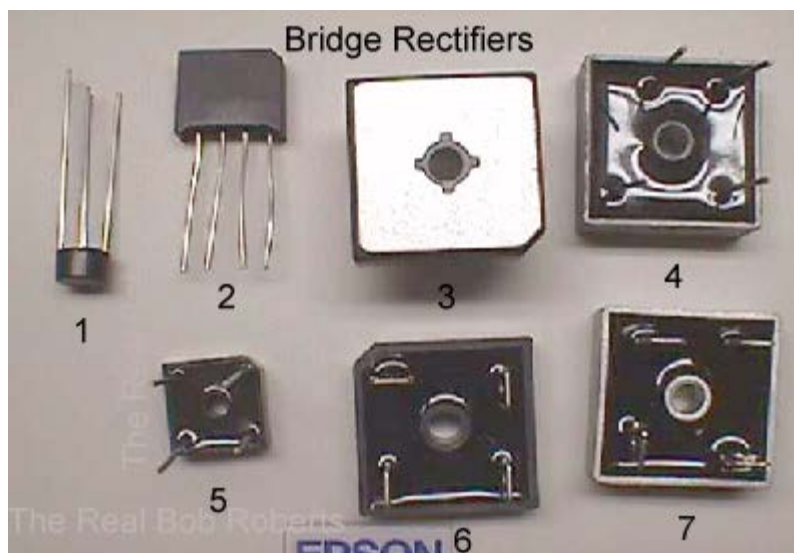
bloodstorm.jpg %d×%d pixels



- Bridge Rectifiers -

Here's a question that I'm asked a minimum of once a week, & most times more than that, so I guess it is time to throw up a quick response here. The basic question seems to be 'how do I know what's what on this bridge rectifier?' and the answer is easy, although there are some variances and some multiple ways to tell. Basically all you need to know is which terminal is the + terminal & the others fall into place for you. The - will be opposite the + & the 2 remaining terminals will be the AC in feed from the transformer in an 'it don't matter' arrangement :) How does the mfr let you know which terminal is + ? It's done several ways... sometimes a couple different ways on the same bridge... with one way being the + lead is left longer than the rest on a wire leg bridge... the pattern of the terminals will be such that 3 are alike with the remaining one being different in it's position or appearance... and finally, by earmarking the case at the + terminal. Well, of course, there is one other way... labeled! This way would have the + & - opposing each other & the opposing AC terminals marked with this symbol ~ .

Anyway, the point is that you can often identify a bridge's pinout with it laying upside down in a parts bin if you know what to look for. K... it's time for the pic that replaces the thousand words now, and I'll go over this handful of bridges pointing out what to look for.



- 1 is a round bridge & it is most commonly marked with the long lead for + making it easy to go in either direction to end up with the - separated by an AC terminal, i.e., positive - AC - negative - AC. Another way of marking this is the case which will have a flat spot right at the + terminal.
- 2 is an inline bridge & is marked by the long lead and/or dog-eared case as in the pic [top right corner of the case]. With the inline type the opposite would be at the opposing end, i.e., the 2 outside terminals are + & - with the 2 inside terminals being the 'non-polarized' AC terminals.
- 3 is a typical 35 amp bridge with .25 quick connect terminals & looking at it from the top as in the pic, it's easy to see that the top left-hand corner is - with the top right being AC, lower left AC & the one that gave the whole thing away, bottom right dog-eared + .
- 4 is a 35 amp wire legged bridge with the one leg in the upper left-hand corner located in a different position compared to the remaining 3 legs, so the odd one out is the positive making the lower right the negative, leaving only 2 terminals for the AC connections.
- 5 is a smaller 6 amp bridge that is marked 2 ways... longer lead at the + terminal & a case that is dog-eared at the top right in the pic.
- 6 is the bottom side of a 35 amp quick connect terminal bridge and it is easy to spot the dog-eared case once again, as well as, the odd one out terminal beside it.
- 7 is the neighbor of 6, but it does not have the dog-eared case, only the odd placed terminal at the lower left marking the positive end.

I guess the easiest way for a newbie to grasp the polarization is to think of this bridge as though it were a battery. You

know that when you put an ordinary "D" cell in a flashlight that the + end has to go toward the lamp and that the - or negative end is the ground for the lamp. Well... this is basically the same, so your cab wires coming from the negative terminal of the bridge are the grounds, while the wires that are going to the + terminal of a big filter cap are the positive DC wires. That should answer the Q of what color wires are on the bridge in my game? It really doesn't matter so long as you know that the 2 AC terminals have the wires attached that go to the transformer, and the - terminal is going to ground while the + terminal is the one that supplies the DC voltage & needs to be filtered through a big cap.

Oh.... I don't get a reading across the 2 terminals...do I need a new bridge? Almost forgot that Q ;) Remember to measure across the 2 opposite terminals marked, or determined to be, AC with your meter set to measure AC and do not try to measure it to ground. Then set your meter to DC voltage to measure the DC from the + terminal to ground... sometimes better to locate a remote ground. This will verify that your ground system is intact, providing you get your expected DC voltage reading.

Addendum:

• **How do I know what size bridge I need to use when replacing?**

I get variations of this Q quite often, such as: I don't see the bridge used in the Atari AC power "brick"My Tempest manual says I need a MDA3501 bridge & I can't find one....What's a suitable replacement for my T3501... and so on. Like diodes & many other components, the key is usually in the part number. I have added more info on the [Parts Page](#) beside each one listed to better aid you, but I will put a brief note here, as well. In both the examples cited above the bridge is ...from the part number.... a 35[amp]01[100 volt]. Generally speaking the first digit/s will refer to the amperage that the bridge is capable of handling & the ending digit/s the voltage it is capable of handling. As Scottie would say...if you put a 2501 in place of the cited bridge, she's gonna blow!... since the bridge is only able to handle up to 25 amps of current even though the 100 volts is sufficient. You could go to an "02" 200 volt, "04" 400 volt or higher & still end up with a blown bridge. You need to at least meet both amperage & voltage of the original when replacing. A good replacement for the cited bridge would be a 3502... disregarding mrf's prefix or suffix.... for 35 amps & capable of handling 200 volts before popping a leg. Much like sister components.... diodes, capacitors & resistors, you can safely go beyond specs, but not below.

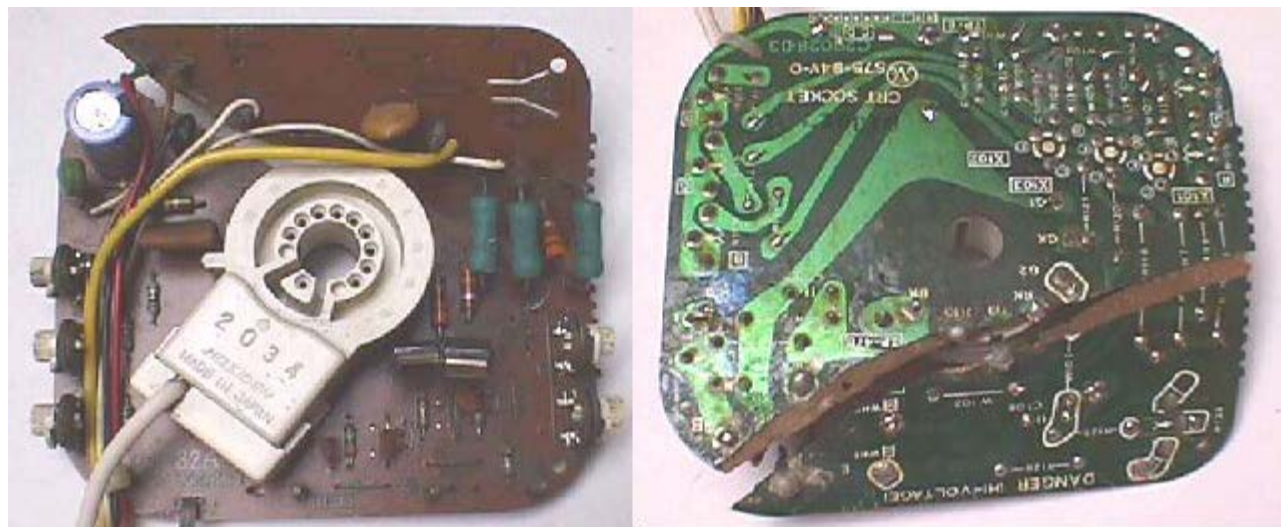
- 1N4001 [1A50v] can be replaced by any in the series up to 1N4007 [1A1000V]
- 3A10 can be replaced by a 6A10
- 100uf160v cap can be replaced by a 100uf200V or better cap
- 220 ohm 1/4w resistor can be replaced by a 220 ohm 1/2w resistor

Broken Neck Boards

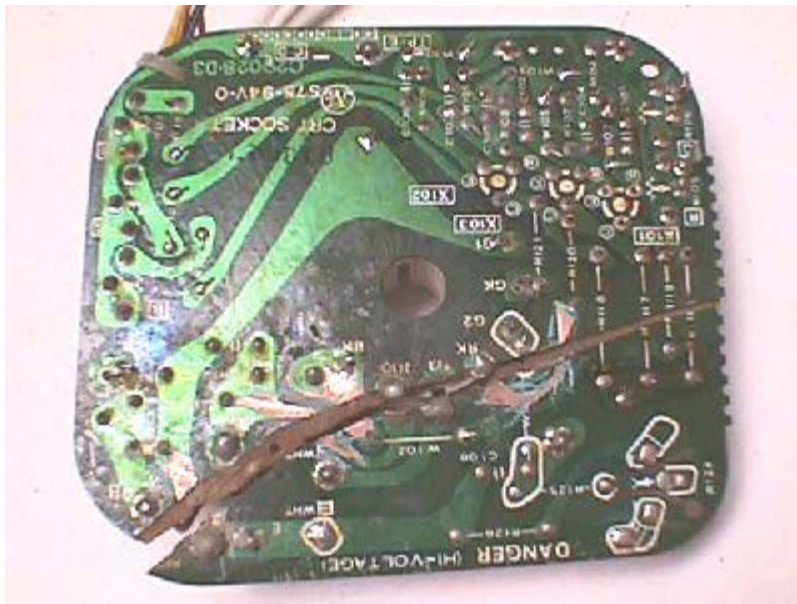
by Bob Roberts

Here's something I've been trying to find the time to put up here for many years now & this Fourth of July holiday of 2007 looks to be the break I've been looking for. Just this week alone I've had 3 enquiries for monitor neck boards. I don't know how many times I've heard it over the years & I usually get this response after telling the person that I don't have what they need... I cracked the neck board & it is no good now & I can't find one to replace it. It had a perfect picture, it had no burn-in & I really need to save it. Some say they had tried to super glue it back together without success & there is no hope of salvaging it, while others don't even try to salvage it, thinking only of replacement.

Used neck boards for many of the different monitors are nearly impossible to find & ones for the very common monitors are usually still in use. Well... there is an ugly way to keep from throwing that chassis on the junk pile & trying to locate a replacement chassis that will work with your CRT/yoke combo that probably won't bring back that perfect pic you strove to save. I searched through the warehouse & managed to find one broken neck board to demonstrate with. This one is more than cracked...it's broken into two pieces, but I've had ops bring some in that were in 4 or 5 pieces, yet salvageable.



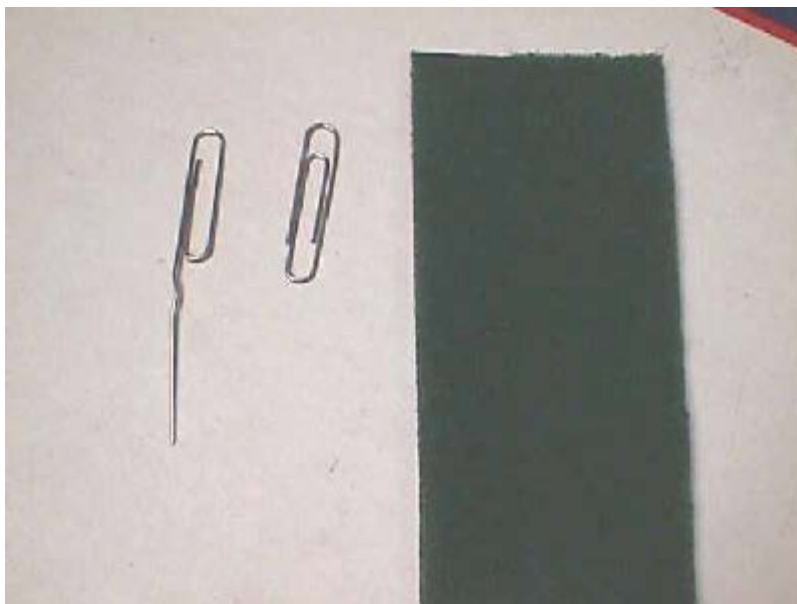
You can see it is definitely broken, so let's get it prepped for an ugly repair. The first thing you need to do is locate all the traces that have been opened along the break or crack. As you find each one use a small screwdriver or hobby knife to scrape the paint off the traces on both sides of the break.



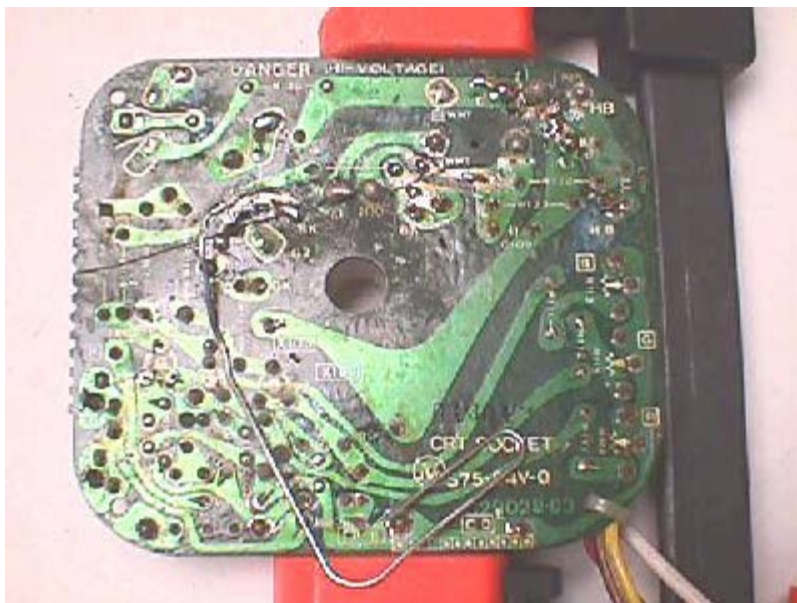
Okay... you have all the broken traces scraped back like in the pic above & now you need to find a way to hold the pieces together while you operate.



I used this ratchet bar clamp that has acted as a third hand for hundreds of projects around here. It holds it firmly in place while bridging each break.



Here's the secret ingredient to a successful ugly repair.... large paper clips! The Scotch-Brite pad is to remove the coating on the paper clip to allow the solder to adhere to it. Bend the clip open & sand it with the pad until it is no longer shiny. Tin the clip & the traces that were scraped back. Don't overheat the traces as they will sometimes peel.



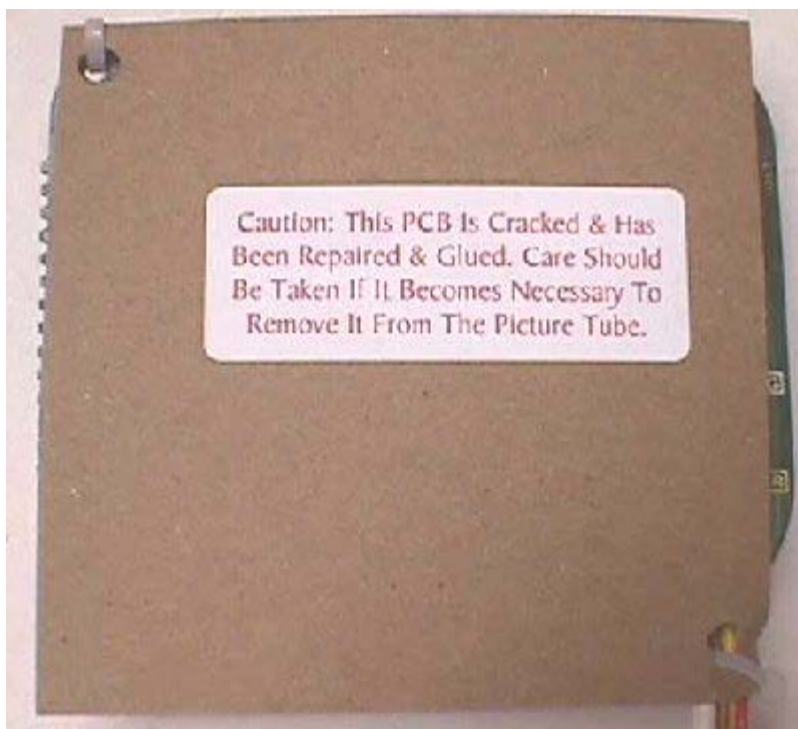
If you have to form any pieces of the clip into "pretsel" shape it will be better to tin after doing so. Then, one by one, start bridging each break with pieces of paper clip until you have them all completed. As long as no other traces or solder joints are in the way, it will add strength to let the clip go by the last place you intend to solder it.



At this juncture, with all your ugly repair clips in place, you'll want take a last scan of the solder side to be sure you didn't miss anything, check each repair thoroughly & then flip it over & check that all the components fell back into place & are not broken in any way. You're satisfied that all is good... then smoke test it.



No smoke... works like new... great. This is where I usually put a two-part insulating glue along the crack to help secure the two pieces & cover up parts of the ugly repair, but, unfortunately, it is no longer made. I would assume that a standard hot stick glue would accomplish the same thing.



You want to hide the ugly repair even better... if there was a cardboard backing on it originally, use it to hide everything, and if not, cut a dense piece of cardboard the size of the back & punch a couple holes where needed to cable tie it to the neck board. In either case, I would be sure to label it as a repaired board, so that someone doesn't come along later & manhandle it into a second break.

Happy Gaming...

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Bob's Button Color Tip

Here is a color tip that has been ignored since the very beginning of coin-op parts that were made of plastic or nylon... colors are not always the same, even in parts made by the same mfr at different periods of time. Where this becomes particularly annoying, especially to a die-hard purist, is in control panel push buttons. There were many mfrs over the years & each one had their own formula for colors... reds, blues, yellows & etc, so colors varied wildly among them with no one formula standing out as the "standard". Joystick handle colors varied over the years, as well, but they were usually only a shade or two off when buying the same type from the same mfr & being separated on the control panel made it fairly unnoticeable in most cases. Buttons, being in close proximity, could be real standouts with the color being ever so slightly different. The inconsistency in colors over the years could lead to a control panel that started out with one color of buttons, having as many shades of that color as there were buttons. Today's microswitch pushbuttons are no exception. If you open a case from one batch and a case from a later batch the colors will most likely vary slightly.

So where's the tip? K... if you have one discolored, cigarette burned or broken button on your control panel & there are other buttons of the same color on the panel, you should get them also... even if they are pristine... to make sure that all buttons of that color match. This applies to microswitch pushbuttons, as well. If there is a slight difference in two close batches, then you can imagine how different the color could be if you are changing one from a 1990 game with a button mfr'd in 2007! This isn't the only thing to contend with as colors fade over the years depending upon how much sunlight they have been subjected to, so it's always a good idea to replace all buttons of the same color when one definitely needs replacing.

Color aside, new buttons, not having been banged on for tens of thousands of times, usually make for a better gaming experience.

The Real Bob Roberts™





11/17/01

Locks... locks... locks! I don't know why, but this is a topic that comes up repeatedly week after week and although I posted several replies in RGVAC in the past, the questions still keep coming... not just newbies, either. Anyway, I guess I wasn't as thorough as I thought I was, so I will give it another shot right here where I can point to it :-)

- *Hmmm... Maybe the importance of locking up your game is to keep the game widow from sabotaging it while Mr Gamer is off foraging for family sustenance :-)*

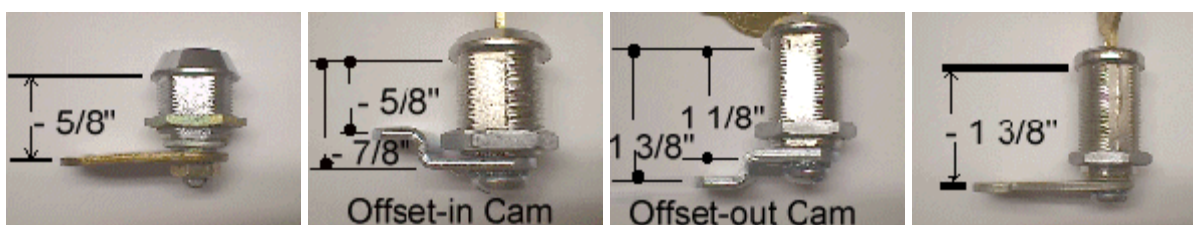
The diameter of the mounting hole for standard cam locks is 3/4" & is usually in a double "D" shape on metal doors.

Double "D" simply means that there are two parallel sides left in the circular hole to prevent the lock barrel from spinning around as it would in a 360° cutout. Jeez... that sounds a little oxymoronic, so I guess a pic is in order, already. I'll put pics below of double "D" plates used to prevent the locks from spinning when you mount them in a wood door after you've drilled your 3/4" whole hole:)



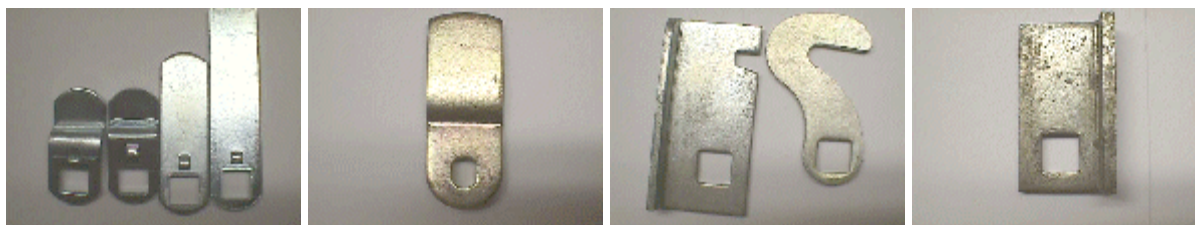
The first pic on the left is just a simple double "D" with four notches that bend out to a 90° angle to act as an anchor into the wood itself when you tighten down the mounting nut. This type often gives under a little pressure & ends up spinning (turning) in the mounting hole. The second pic shows one with the 4 little *tacks* and two holes for using screws for additional staying power. Now the third one is strong enough to actually cut out the remaining portions of metal on it to make it into a full circle after mounting it to the wood on the cab. The final pic shows where the term 'double "D"' comes from. K... we're through the wood & off to grandma's :-)

The cam locks are sold by the length of the locks. This is measured from the lip that prevents it from just passing through the mounting hole & out the other side, to where the actual cam mounts on the opposite end. The sizes as used over the years in coin-op range from 5/8" [a less common type most notably used by Nintendo & in vending machines] to 7/8" [the most common one used on a vast majority of coin doors] to 1 1/8" [very common to accomodate the 3/4" deep wood back doors on vid games] to the final 1 3/8" [primarily used in jukeboxes to access levers for multiple cam latches], but for vid games the two typical lock sizes of 7/8" & 1 1/8" will handle all your needs.



The 7/8" lock above has an offset-in cam attached showing how it can be used in place of a 5/8" lock. The 1 1/8" lock

has an offset-out cam attached showing how it can be used to replace the 1 3/8" lock. Of course, you can swap them around to be used to replace each other, i.e., the 7/8" with an offset-out will replace a 1 1/8" lock and the 1 1/8" lock with an offset-in cam can replace a 7/8" lock.



The pic on the far left above is of a few sizes of standard cams with stops. The second pic is of a cam that typically goes with an Ace, Gem or other brand of high security locks that ops often put on their machines to stave off break-ins. I wouldn't recommend using this type for your games as they are case hardened & require a special \$40 circular drill bit to remove them if you lose your key & have no alternate means of entry available to you. As though that were not bad enough, the bits are typically good for two lock removals before their teeth fall off. I'll put a pic of the lock and the bit below. The third pic above is of a couple different cams used to hold down cocktail cabinet tops... or also used to latch down jukebox lids, vending machine doors and a variety of other coin-op uses. The fourth & final pic is of a common rigid type cam used for back doors on the vid games & juke cashboxes. Very rugged cam... to the point of most lock cylinders breaking off before they break with any attempts to break-in through the cabinet back door :(



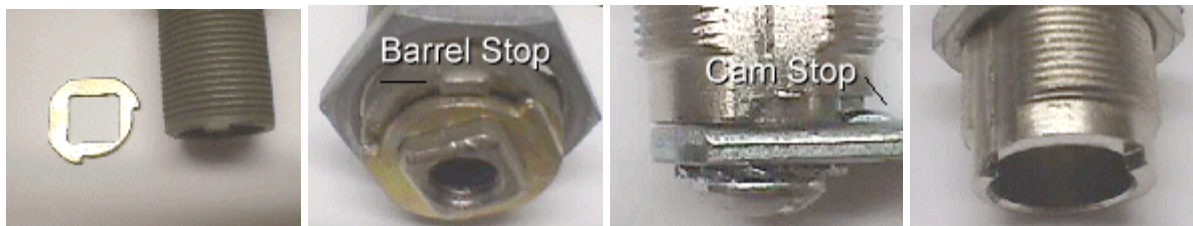
Incidentally, I tried to buy these drill bits above from local locksmiths & was refused, so I hunted down a locksmith supplier thinking that I could buy these from them.... no sale once again! I mentioned it to one of my customers, who as it turns out, just happens to be a locksmith :-). He bought some for me locally & found an out-of-state supplier for me. Just one more good reason not to use this type of lock on your home games.

I guess it's time for me to paste some of my original texts in here to save a bit of time. If I get any more first time questions about locks I'll be sure to add the reply here, as well.

Bally/Midway coin doors & most all over/under coin doors use the 7/8" cam lock set with a 1 1/8" straight cam. You can use the 1 1/8" cam locks in place of them by going to the 1/4" offset-in cam. All this does is make up the 1/4" difference in barrel length between the 7/8" barrel & the 1 1/8" barrel. Some of the older games used the 5/8" cam locks with a straight cam & again, you can go up a size to the 7/8" lock set & use the 1/4" offset-in cam to make up the difference.

Back doors are most commonly 1 1/8" locks with 1 3/4" straight cams. There are exceptions that need the 1/4" offset-out cam to get past a center door stop, or use a 1 3/8" lock set with a straight cam. There are also a few that use the 7/8" lock set with either the straight or 1/4" offset out cams as they are recessed into the back doors' wood to allow for barrel length differences.

Some brands of lock sets use cams that are reversible & used as either offset-in or out as they have no stop tab. 90° movement is accomplished by a notched spacer which can be any degree from 90° to 270° which is placed on the end of the barrel & the stop tab is actually on the barrel housing rather than on the cam itself. Cams with the stop tab can be used in reverse situations, but they will spin 360° with the key in place...no stops. However, if they are used in reverse on a barrel stop type, they will work just fine.



Once installed, you can have slop on most of them and the best way to remove it & get a tight door fit is to remove the control panel and lock the coin door. Pushing in on the coin door you can now eyeball or measure the distance between the cam & the door strike. It is tempting to just grab a pair of pliers & bend it in to meet the strike, but this will do several things. First it will mar up the cam at the very least & there is a danger of breaking the retaining screw in the end of the barrel, and secondly, if your barrel is a strong one, it will bend your coin door front out of flush.

The best way to do this is to remove the cam taking note of the direction you need to bend it in. If you have the luxury of a bench vice, you can put a couple pieces of paneling in it to act as a cushion so you can place the cam in between loosely and using a pair of pliers on the barrel end of the cam, gently bend it to the position you need & then retry it on the door.

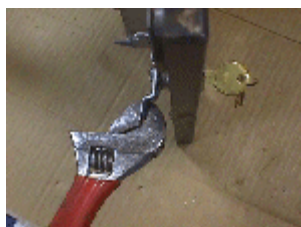
If you have no vice or are on location for ops, you can grip the cam in the same manner with the pliers on the end that goes over the barrel, and place the end of the cam on a concrete floor or sidewalk & step down on the pliers with your foot to accomplish the same bend without screwing everything up. In my younger days I use to do this with 2 crescent wrenches more or less freestyle in the air, but as I got older, I wasn't able to handle the quick punches to the chest when one of the wrenches would slip off the cam :- (There were not as many slips when using them in conjunction with the vise, but again, it can be mean if you slip off the cam. I remember ripping my knuckles open on one such occasion and how painful it was, but they do a nice job bending the cams if you are careful.... and young & strong doesn't hurt, either :-)

The jaws of the pliers in both cases aide in protecting the barrel end of the cam from bending out of shape & not seating back onto the barrel properly.

Once your top door is tight in the over/under case, you will want to make a duplicate cam for the bottom door & once you have both secured you can replace your control panel.

The same applies to the back door with the exception of measuring the distance you want to tighten. First install the closest fitting lock set to needed & then turn the key to an almost locked position and pull on it to see the distance the back door will pull away from the cabinet to judge how much of an offset bend you'll need in the cam to make for a tight fitting door.

That said, if your coin door is just a tad off & you use care, you can tighten them while mounted with a crescent wrench. I'll put another pic below to illustrate this, but it is not a good idea to try this on back doors since so many are made from pressed wood, particle board or chip wood that any measurable force applied can actually give you a handful lock with a trapezoidal or pie-shaped piece of *wood* attached to it :- (



Another question that arises from time to time, is 'can I salvage any of these old locks that I have removed?' & the answer is yes. You can make an old spare key fit a lock that uses the same type of key, i.e., the key must fit into the barrel, by filing notches where needed & filling in unneeded ones with solder after wire brushing for adherence. You can remove some of the pins from the cylinder... down to just 1, if you want... or simply move them around to needed

positions if you want to keep it intact. Saving any of the pins will insure that you have a properly spaced one available for your next experiment. BTW: You need to watch for flying tiny springs that are used for returns on the pins, also.

Another thing that I have saved over the years is all those keys! I don't know how many times they have come to the rescue on a machine that was without keys & impenetrable.... always something where a chain saw was just out of the question :O Give the new guy the box of keys & let him have at it! I've had many a first try and many a last tried key pop 'em open like magic. (Always wanted to go to the racetrack on those lucky days :-)

Here's a few ways to get into a machine without keys or a chain saw... another often repeated question. Some vids are easy & by simply removing the marquee & flo, standing on a chair with a flashlight you can then see the screw that holds the cam to the back door lock... remove it & in turn do likewise to the coin door lock from the now open back door. Note: Have a catcher in the back of the game for the falling door. If you find that the screw or nut is just too tight for you to loosen, sometimes the 2 screws that hold the double "D" plate can be removed & the whole lock spun to effect the opening.

If your vid has the 2 recessed plastic handles in the top back you can sometimes remove them & by reaching in through the holes with a short screwdriver & feeling your way around, find the back door cam screw & remove it for opening. Sometimes just carefully looking over the back reveals some portion of the back that is simply screwed on & can be removed for access to the game.

If you have only the coin door key.. or it is open... and you need to gain entry into the back or the cashbox, you can remove your CP & monitor glass to access other areas... sometimes going as far as removing the monitor itself, if it is a front mounted one. The entire over/under assembly can usually be removed by backing the retainer clip screws out & pushing in on the retainer clips. Here's a pic of another useful tool in this situation :-)



March 2008... How long have Alice & I been here helping out... hmmm... maybe a fresh look at our grandson Jon, above, as he appears today will help with a time line!



Hopefully this will provide the answers you're looking for pertaining to cam locks. The locks are available on the Parts Page under "Hardware" if you're looking for new ones.

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Cheap Audio Amplifier

by Bob Roberts

Over the past ten years I've been asked at least one hundred times how to get audio amplification cheaply for use with game boards that require a separate amplifier or to use in a cab for stereo, or faux stereo adaptation. It seems no one wants to lay out big bucks just for sound & would rather devote a little labor in attaining it, making for a new fun project in the process. The answer that I always give is to buy a cheap pair of amplified PC speakers. Everything you need is right there and at a fraction of the cost of an a standalone amplifier.... probably better than one you'd make from a scratch kit, too. These sets sell from \$8 to \$20 new, but often times you can pick up a used set at local weekend flea markets for \$3 to \$5. Many times when I've suggested this the person responds with, "oh, I have an old set I'm not using" or something like my buddy use to build PCs & has a whole garage full of them.

A lot of people had trouble grasping this from just my emails, so I've grabbed a Mr Do & Mr Do's Castle PCB from the warehouse & will walk through adding this cheap, little or no money, amplifier to an adaptor allowing sound when used in a JAMMA game.

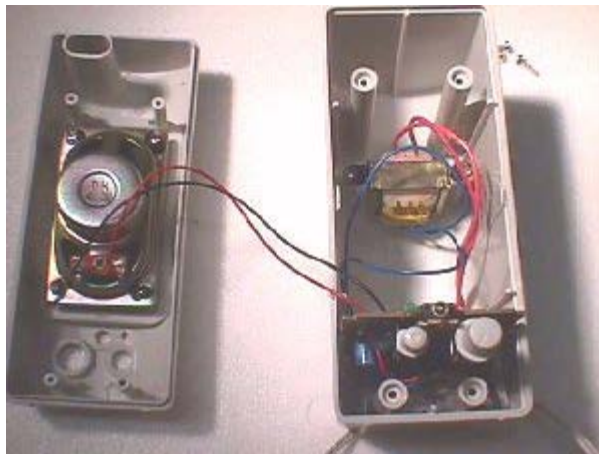


The obvious first thing needed is the PC speakers. I grabbed one of the sets that are on my Flea Market Page at \$10. If you're looking for these locally keep in mind that the keyword on the package is going to be "*amplified*" as many older sets were not amplified & therefore, contained no audio amplifier inside :- (I found cheap unamplified sets like this all over the net at \$4 to \$7 a pair, so the keyword must be stated in the ad or on the box & sometimes a little more expensive pair may contain a better grade amp, as well.

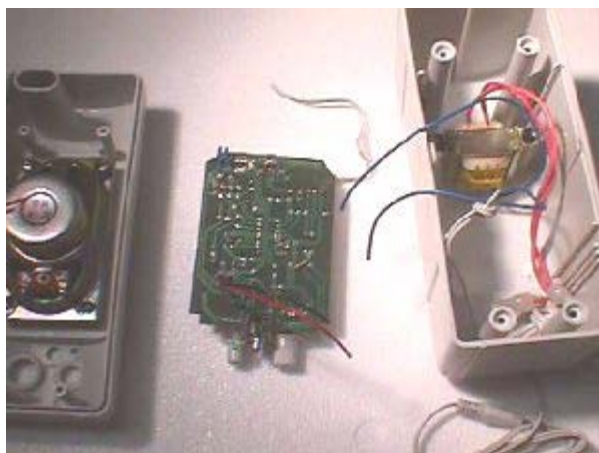
Another thing to keep in mind when looking for these is the operating voltage. I've found that ones that operate on 6 volts, battery or adaptor, don't seem to work as well as 9 or 12 volt ones. You are actually better off looking for a set that operates on 115VAC. As with most electronics that operate on 115VAC, the voltage is dropped to 12 volts with a stepdown xformer inside & 12 volts DC is readily available in your cab.



Okay... you've got the speaker set you want to use & once you open the box all you need to look for is the one with all the main cabling on it & take it out it's usually on the top, so everything else can be left in the box untouched.



Remove the 4 screws from the back & separate the 2 sections leaving the wires between each component until you can ID them. You can now see the amplifier board that the mfr has hidden away in the case. Most just slide in & out of a track on the case & are easily removed. If you are unfamiliar with the wiring to & from the amp bd you may want to jot down the wire color code & their purpose. The red & black wires in the pic above, going to the left, are obviously going to the speaker itself. You can cut those wires about an inch from the speaker leaving plenty on the amp side for reconnection.

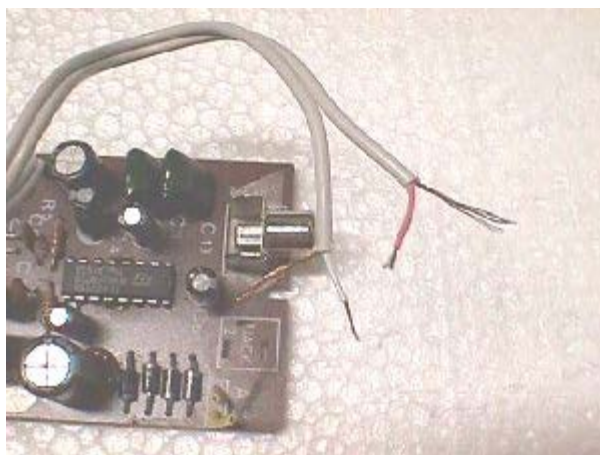


Next look for the AC line cord coming into the case & you will see that the

wires go to the input side of the stepdown xformer. Just in case you got ahead of yourself here... make sure that the line cord is NOT plugged in!! It's not :-)
 Okay, look for the output wires of the xformer & follow them down to the amp bd. It's not going to help you for me to refer to colors because they are going to be different from one set to another, but I will use them only as reference in the pics I have taken. In the pic above the output wires from the xformer to the amp bd are blue. Since we are not using the xformer for power you need to cut those wires about an inch from the amp bd... that inch leftover is just for a marker, so that you don't lose sight of the power entry.

The only wire left at this time is the input wire... the wire that has a plug to connect to your PC. This wire should be cut about 6 inches from the amp bd to make sure you have enough to work with.

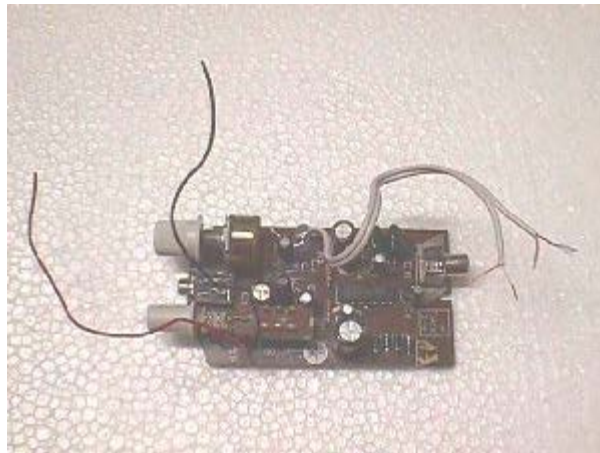
That's it!! You've extracted a good amplifier. The basics are a pair of wires to attach to the speaker & an input cable to attach to the game bd's output to be amplified. All that remains is power to the amp bd & we'll add those wires, so that it can be color coded to DC power after a little more modification.



Let's prepare the input wires first. They are shielded wires, so the ground is actually the wire mesh that is wrapped around the center wire. You need to strip these back & separate the leads. Take care with the center wire as it is usually a small gauge that will break very easily if too much pressure is applied. I'm not using stereo for these Mr Do bds that only output mono, so I'm going to combine both grounds & both center wires to feed the mono output to both channels of the amp.



Solder the ends of this pair to keep them from unraveling while working on this bd & it will also prepare them for soldering to the adaptor.



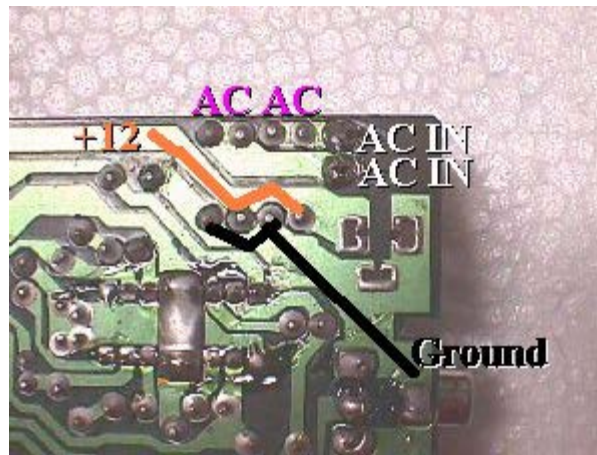
Okay.. let's get the power entry fixed up to go now.



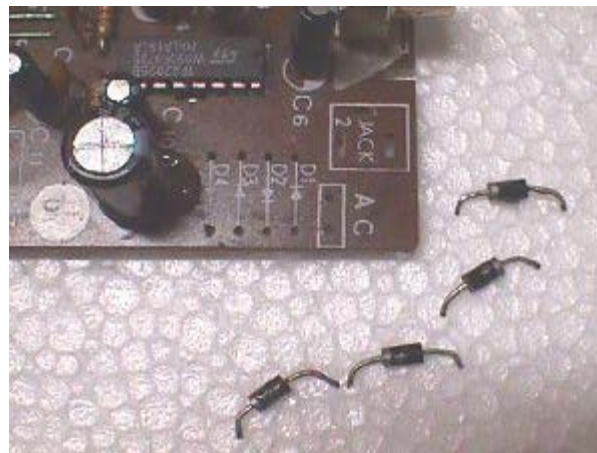
You need to locate the bridge rectifiers that are fed by the 2 AC in wires that were left as markers. One type of bridge is pic'd above... it's diodes are installed vertically & I've put the pic here just for reference in case you run into a setup like it.



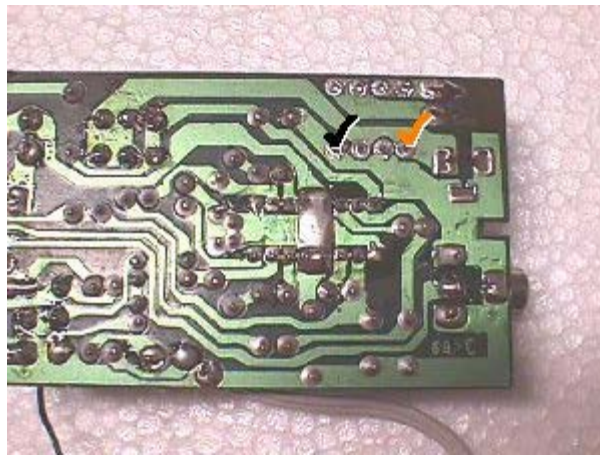
This is the typical bridge assembly most often seen in electronic equipment. We do not need this bridge nor the AC markers that were left, so we are going to remove them, but first let's flip the board over to see where we are going to add our DC power wires.



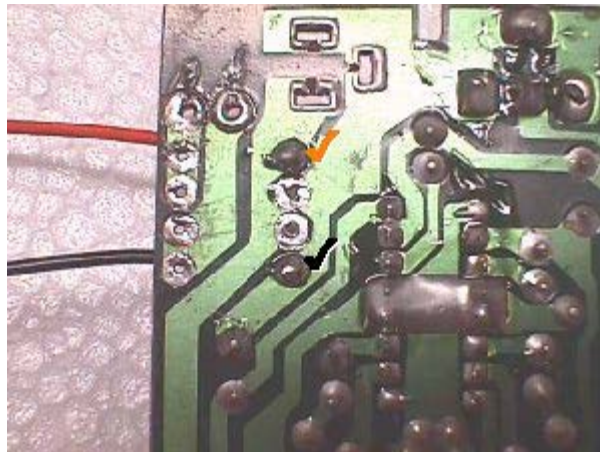
You can see from the pic above where your +12 volt orange wire should be attached & where the ground needs to be attached. All PCBs are not going to be traced out like this one, so the easiest way for you to locate the + & - of the bridge is to see which of the 2 conjoined pads also ties into metal ground pieces such as the speaker jack, metal casing of the volume pot or the ground braiding of the shielded input lines. This one will be -, obviously, & the remaining 4th junction has to be the + by the process of elimination. Four tie points, 2 are AC & now we know the third is ground, so the 4th has no choice but to be the plus DC voltage tie point, so you don't even need to know how to read a diode or bridge :-() Another quick clue would be that your 12 volt line is generally going to be tied directly to the on/off switch.



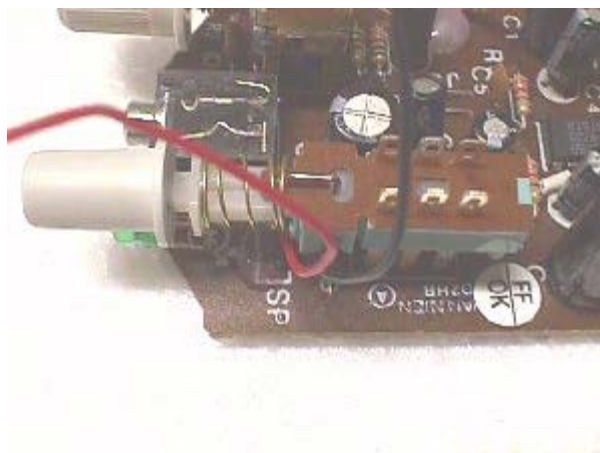
K... now you can pull the four diodes that comprise the bridge & the two marker AC wires that were left behind. This particular PCB has AC... IN.... Speaker & others imprinted on the board, but that's not something that will always be there, so you have to have an idea of what goes where.



Next cut two pieces of 20 gauge wire... one orange & one black... about 6 inches long & strip the ends. You can use either pair of empty diode positions to feed these wires through the bd. I chose the 2 in the pic above & the orange wire goes to the pad that was established as the +12 volt, while the black goes to the one established as the ground.



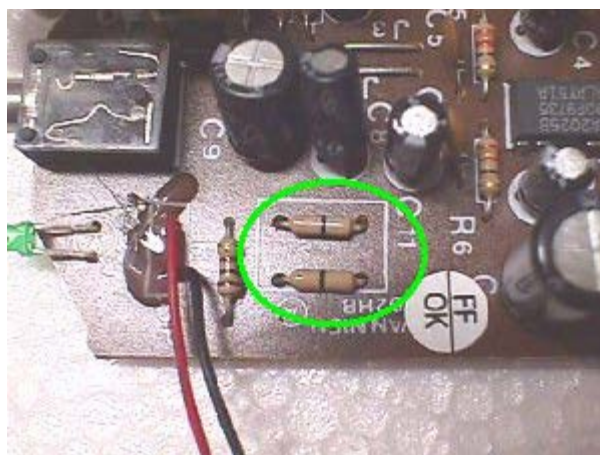
After soldering the wires in place make sure you don't have any solder splashes. You can fill in the rest of the empty holes or just leave them. Next... twist the two wires together for use later on.



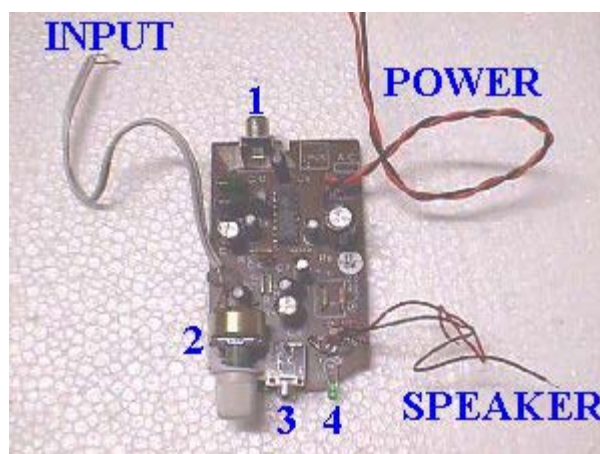
This amp bd is only going to power up & down with the game bd it is used with, or the cab it is put in to, so we don't need the switch on the amp bd. Remove it & if it's like the one in the pic it can be used as a replacement on one of your Williams games when needed.



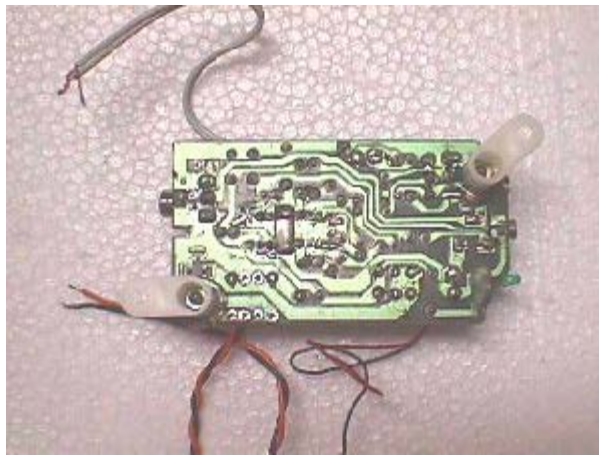
Now that the switch has been removed the pads must be jumpered to be in the "on" position all the time.



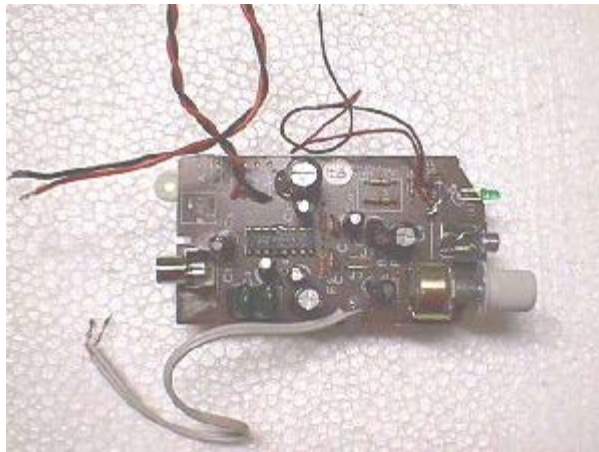
In the pic above I've jumpered the switch closed with zero ohm resistors, but you can use bare wire, insulated wire or even a common paper staple or clip, if nothing else is available.



Ready for mounting! I left the RCA jack (1) in place for an easily added speaker...PnP. The volume control (2) obviously had to be left on the amp bd. The headphone jack (3) was left for those late night games where you don't want to wake the boss & the LED (4) was left as an idiot light.



For the Mr Do adaptors I've simply put a gob of hot glue on opposite corners in the flattest spots available & stuck a couple PCB feet in it. It would be best to place one of the feet under the volume control to help support it when in use.



You could mount this to a piece of wood & connect all the I/O up in one connector with a mate in your cab as a permanent cab amp. The possibilities are unlimited... wire in a couple speakers for stereo operation... relocate the volume control from the amp bd to the coin door area... switch it for mono single, dual or stereo operation... wire it to simple PnP connectors inside the cab... you are limited only by your skill & knowledge level.

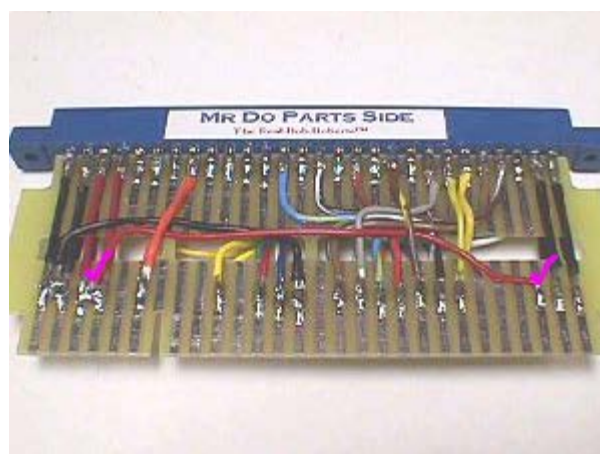


K... I'm starting with the Mr Do's Castle board above & while I'm not going to go over the adaptor building itself... covered many other places... I am

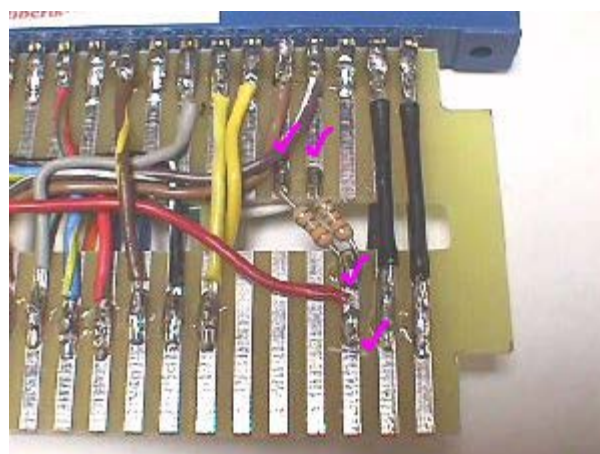
going to put a few notes that may be stumbling blocks on this particular bd.



The first thing is that this bd uses a little wiring wizzardry between the coin switches & coin meters. The coin meter voltage actually is used to pull up the coin switch I/O lines, so just trying to connect directly to the coin lines will result in not being able to coin up a game. Obviously, you don't want to mount coin meters on an adaptor nor do you want to rewire your coin door to operate with this bd. Hacking a classic bd is out of the question, so a little wiring wizzardry has to be accomplished on the adaptor itself.



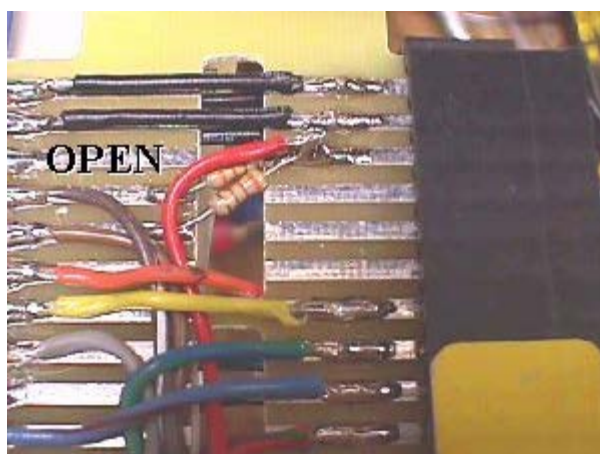
The first thing to do is get 5 volts down to the other end of the adaptor & this can be done with a red jumper wire from the 5 volt pad down to pin 26 on the finger bd. Solder it on at mid trace.



Now you can add a pair of 330 ohm pull up resistors to the coin lines as pic'd above. You can cut the trace going back to the JAMMA harness just in case pin 26 is used & switched on your control panel. This will eliminate the possibility of accidentally shorting your 5 volt line to ground.



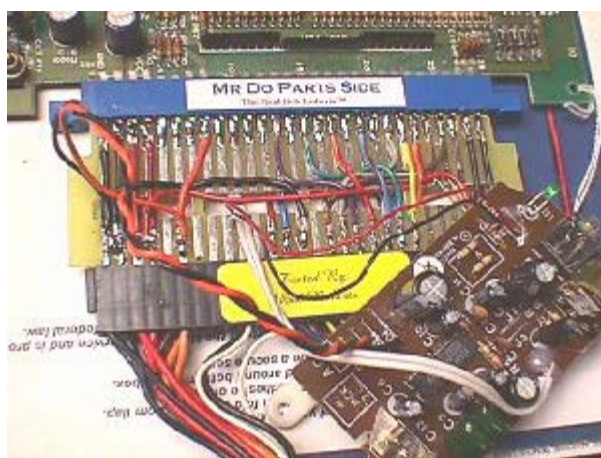
This same adaptor can be used on the Mr Do game bd. The Mr Do, however, has pin 26 on the bd going to ground, so you don't want to use this position on the adaptor bd side. It is not necessary to connect up all 6 ground fingers on this end of the bd... the standard 27,28,e & f are plenty adequate along with the other end's 1,2,A & B.



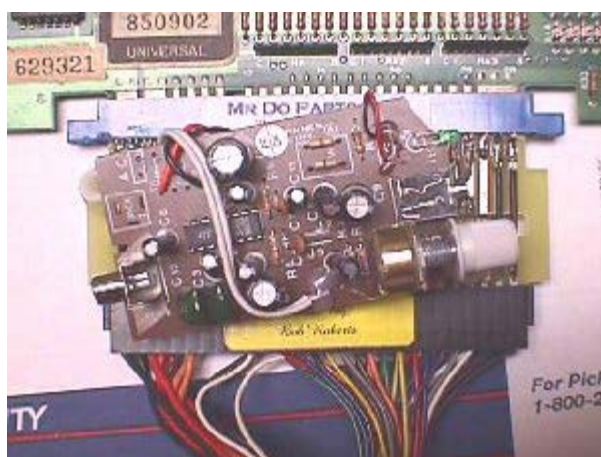
K... it's 4:30AM & I'm not sure I understand what I just said, so I'm going to take another stab at it. If you have a Mr Do adaptor already, it may have pin 26 & d wired to ground on the adaptor as the last 3 positions on the PCB are a single wide pad. If it is jumpered on the adaptor you need to remove it & if you're building an adaptor to Mr Do, don't use the position marked in the pic above as OPEN on either side of the board. As far as the pull up resistors go, they can be left in place even though the Mr Do doesn't use the same coin configuration & does not require it to be done.



K... let's add the amplifier starting with the input since it connects on the solder side of the adaptor. The audio + output is on pin L & the audio - is on pin M.



Now the twisted pair for power needs to be added... orange wire to 12 volts & black wire to ground. Only the speaker wires to hook up now.... red to JAMMA side pin 10 & black to JAMMA side pin L. Give it a quick once over, put a piece of cardboard between the adaptor & the game bd to act as a temporary insulator & fire it up for a test run.



Everything works fine... put a dab of hot glue under the two PCB feet on the amp bd & stick it to the top of the adaptor where it best fits & you're done.

If you're not too fussy about your sound you could strip out the leftover

speakers & incorporate them into your cab. As I said, the switch could be used for a WMs game & the stepdown xformer could be used for powering coin door lamps in a project.... leaving only the box & plastic housings to chuck out.

Incidentally, the 2 boards & 2 adaptors from this article are for sale at \$50 each piece or \$90 for either bd/adaptor combination.

Happy Gaming...

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Coin Counting

by Bob Roberts

Keeping track of how many games have been played on each of your collection pieces must be the objective lately...2009/2010... as so many have requested info on hooking up coin counters. I'm going to toss up a quick page here in words that even I can understand... non-technical as possible. Let's start with is it a counter or a meter? The two have become synonymous, so much so that even mfrs routinely use both words... sometimes in the sentence. One of you reported that using "counter" on Google would refer you to bulk counters of loose change such as ops used & banks use. I guess that is true, but using "meter" would probably be just as ineffective. From this point on I'm going to refer to it as a counter.

Coin counters were obviously used at the onset of game machines to keep an accurate account of coins in the cash box keeping all parties honest. Later on with the advent of electronic bookkeeping many machines dropped the electromechanical counters. It was soon apparent that was an error since a battery was involved along with other components that could fail... hence both were used.

Coin counters are available in any one of a dozen operating voltages, but for the most part you'll be dealing with either 5 volt or 12 volt ones. The first thing you need to know is that you'll need a suppression diode referred to as a clamping diode. This is just to block the operating voltage from feeding back to your PCB where it could do some damage. Newer counters will have one internally & will be color coded with one red wire to go to your source voltage & one black wire to your PCB counter output or whatever trigger you are using to pulse the counter. Older counters are likely to have two black wires even though they may still have an internal clamping diode. You can check for diode action with your ohmmeter... flow one way & not the other. If no internal diode is present you'll have to add one externally... banded side to voltage source & other end to PCB.

Simplified... the banded side is always hooked to your supply voltage & is just sitting there hot & waiting for a ground pulse to trigger it into action.



In the two counter versions above you'll notice the top end numbers are shown & this is oftentimes questioned. The reason for this is allow testing prior to the "000000"

starting position permitting easier bookkeeping.

Now, as you old hands already know, you can hook these counters up to your coin in lines allowing them to pulse every time a coin passes through the trip wire. You can hook up 2 counters if you have two separate coin in lines or just one counter to keep track of both coin in lines if they are looped together. If you do this you'll need an additional blocking diode when using 12 volt counters. This diode will be in-line with the banded end facing away from the coin in pad on the PCB. This will block the 12 volts from back-feeding to the PCB. If you use both coin 1 & coin 2 input lines with separate counters, or a single counter for both, you'll need a blocking diode on both lines.



The 5 volt counter above is equipped with two ways of mounting. It can either be mounted using the metal mounting flange on the bottom, or that flange can be removed to allow it to front mount on over/under coin doors using the the two threaded mounting holes on the face.

The common 5 volt type (42-2093) with diode & mounting bracket is available on the Parts Page at \$5 each if you need replacements.

[Counters](#)

Happy Gaming...

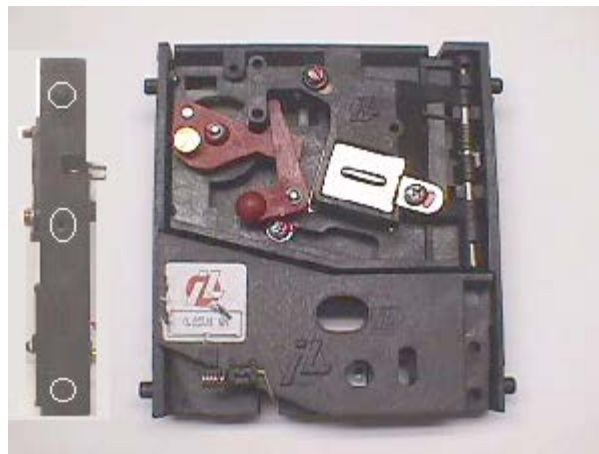
Coin Mech Help

By Bob Roberts

There seems to be a whole lot of interest in putting coin mechs back into the games at this time. I know I am getting questions about them on a daily basis, so I thought it was time to add this little tid-bit to the Help Pages to save a few minutes in email. I've been getting Qs like... "What type of mechs do I need for a Galaga?".... "What should I use for mechs in a vertical mount coin door?".... "What holds the mechs to the coin door?"... I have coin mechs, but they are the wrong type for my door & I need to know which ones to get."... and a host of other Qs that seem to be related to simply mounting them back in the coin doors. I've taken a few pics of different types of mounting situations & I'll attempt to clear up some of the Qs without rambling too much.

The first thing to know is that most of the Qs above can be answered with one statement.... coin mechs are universal in design. We'd be in a real fix if they weren't. I can see the warehouses stacked to the ceiling with coin mechs at this stage of the game if they were all different :-(Hmmm.... the mech holders, as well, following that logic. I just had visions of a guy standing on the corner saying, "Psst... hey buddy, take a look at these rare Ms Pac coin mechs! What a deal I have for you! \$100 will steal this pair from me today, & TODAY only!" :-)

Just to clarify here before I get inundated with email, I'm speaking in general terms about the mechs as used in video arcade games. I don't want the first email saying... Hey, I took the mech out of my Rowe CD box & I can't get it to fit my Street Fighter II :-) Enough daydreaming... let's start off with a typical coin mech as pic'd below... a Happ, no less... and you can see that most ship with the 4 outer mounting studs in place. If you're doing a Ms Pac or other Midway of that vintage, these will pop right in without doing a thing to them.

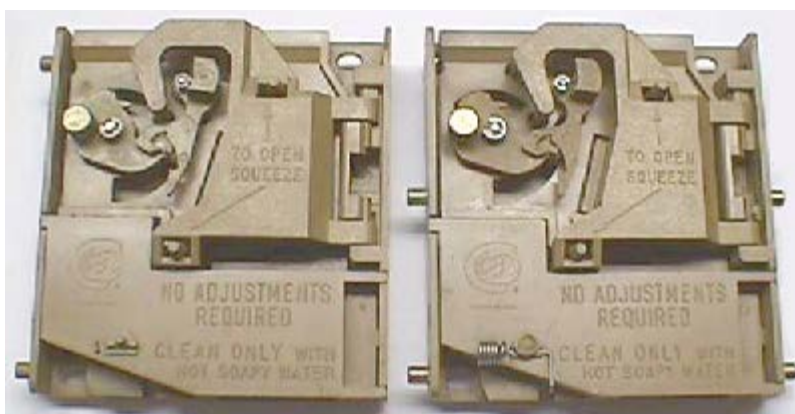


The first thing newbies notice about the mech is that the 4 corner studs are made right onto the base. It appears that you have no option but to install them parallel to the door front (commonly referred to as horizontal mounting), but that simply isn't the case. They will mount in any type holder if you know how to install them. You can barely see the pattern on the side view, so I circled them... the 2 studs that seem to disappear all together, and the predrilled hole for a center stud. Incidentally, this center hole, when a mech stud is installed, usually pairs with either the top or bottom stud for mounting in channel holders & you can leave the unused stud intact, i.e., it doesn't interfere with anything else, as it obviously would if you tried to mount it in a Midway with the center stud in place.

Before I get into how to make these fit, let's take a look at the Imonex below. You'll see it has the same mounting pattern on the base. There are a couple differences over the Happ mech with the first being that this type mech has no moving parts. On the right is a pic with the mech held open so that you can see the intricate maze that guides the coin toward the coin switch. Pretty poor pic, but the best of several that I took :-(The other difference is in the mounting studs, which are still made as part of the base, but on these they are hollow, as opposed to the solid ones on the Happ. It is somewhat of an advantage when you are trying to fit the mech to a different type of holder, as you'll see later on.... if I ever get to it :-) Rambling... rambling... rambling!



The pic below is of a couple old Coin Acceptor mechs that were setup in two different mounting apps. The one on the left was mounted in a perpendicular to the coin door front fashion (commonly referred to as vertically mounted) , while the one on the left was mounted in a channel holder similar to a Midway, but only half the size. The one on the left still has two of the plastic studs that are made as part of the base & the opposite side has had them cut off. The one on the right has had all four of the ready-made plastic studs cut off & four metal mech studs installed.



You can see above left that these mechs also had the hollow plastic studs. By now, you've probably caught on to the fact that these ready-made studs do not have to be used. If they are in the way, simply take a pair of flush cutters & snip them off. The advantage with the hollow studs that I spoke of, is that when you snip them off your hole is already in the base for you to screw on the metal mech studs where ever you need them.

The pic below is of a Happ mech that I snipped one side's studs off from. On the top, I simply sanded it smooth & left it, but the bottom one I took a drill bit that fit into the center predrilled hole & used it to drill a hole where I had snipped off the ready-made stud. Now, if you look at the predrilled hole on any plastic mech, you'll see that they have it beveled to

aid you in threading a stud into the plastic base... making it's own threads as it goes... so what I always do is take a pocket phillips screwdriver & twist it into the holes that I have drilled to bevel them in the same manner. It's always worked great for me, but you may want to take a larger drill bit & ream the top of the hole that way. I'm sure that you could do that just twisting the bit in your hand, as well... no drill power needed. The plastic is very easy to work with.



Let's look at a couple vertical apps. The type pic'd below is one whereby you have to snip off both ready-made plastic studs on the hinge side of the mech, but do nothing on the other side as it will drop right into the channels on the holder & then the swivel catch snaps down on the bottom stud locking the mech into place.



Then you have the solid hole holders & many have asked how to get the plastic studs through those holes :-(You know... do I bend the metal frame up to fit over the stud? No..... it's really a pretty simple solution.



First you snip off both ready-made studs on the hinged side of the mech & sand it up a bit for a snug fit. Then snip off the remaing two studs & drill holes dead center of where the studs were removed, if they weren't the hollow ones, &

slide the mech into place, fastening it with two 1/4" philips head screws as shown below.



See.... it's all pretty easy once you know the secrets :-)

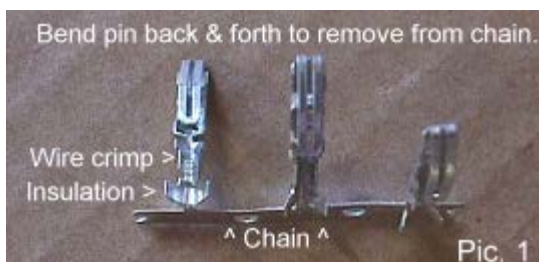
Happy Gaming....

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Crimp Mystery

by Bob Roberts

I've heard over & over again, statements made about crimp connecting to the effect of, "I just can't do them right", "the pins fall off after I crimp them", "they are not as good as soldered on" & an assortment of others. This is my feeble attempt to inform people on the proper crimpers to use & the use of them, at least the way I use them, anyway. I'll use the Molex split pin for an example. This is a pin designed for a Molex single or double sided .156" (3,96mm) edge connector and is actually a bifurcated contact terminal in the proper terminology....pin is much easier.

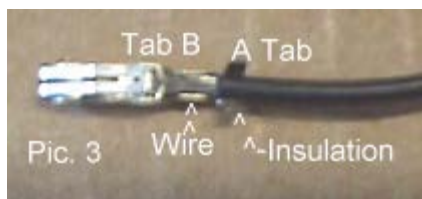


The pins, as pictured above, are gold & nickel plated at the wire crimp (conductor tab) for a better connection on this brass based pin. The insulation crimp (tab) will hold up to two 18 gauge stranded wires.

In the second picture (Pic. 2) above is the best all-in-one coin-op crimpers ever made, IMHO. I don't like using them as the instructions suggest & watched every new employee fumble with them following their instructions, and found them & myself, too slow in getting the job done the way they describe. Their picture also seems to be a view in which you are facing the person using them, which adds further confusion, so I will explain this my way rather than from their instructions.

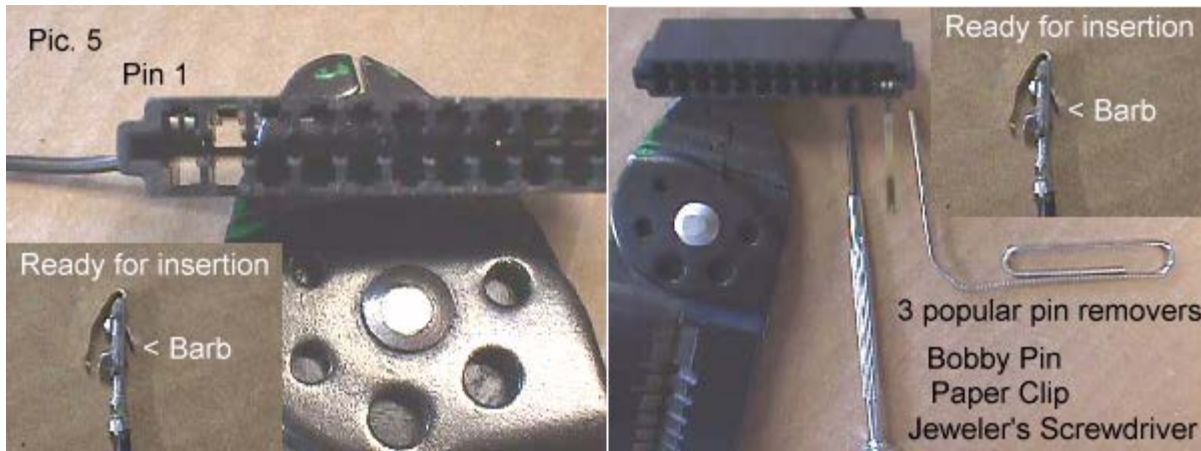
The first thing I do with a new pair of crimpers is paint the top edge green or red, with the tool facing me so that I can read the engravings on it. No matter how busy I am, or who I'm talking to at the time I pick up the crimpers, my eye catches that painted surface and guides me to having them in the proper position without a single hesitation....right side up & the correct side facing me. You might have noticed the small drip of green paint running over the top edge by the "A" in Pic. 2 on my set above. On employees sets, I also painted a thin line of silver paint straight down the center of the anvils at "A" & "B" in the picture, so that they would crimp down in the proper places.

Now we are ready to use them & the *come with* instructions say to strip back the insulation on the wire about 3/16" which is what I do (Pic. 3). In the next step, they say to load a pin into the anvil & hold it in place with the crimpers while sliding the wire in. This is too slow for a hobbyist, let alone someone trying to make a living with tools, so I do just the opposite.....I load the pin onto the stripped wire, which I have to hold anyway, so holding the end of the pin to the wire at the insulation tab is a quick & easy way to accomplish 2 things at once. Now my right hand is free to use the crimpers & position them where they are needed.



Some tabs are flared out quite a bit on pins, so I start the wire tabs in "A" anvil so that they begin the turn inward before I put them in the "B" anvil (wire crimp anvil) for their finishing touches as depicted in the picture on the right above. I also do this with the insulation tabs, but you shouldn't bare down too hard in the "B" anvil as you can pinch out an excess unwanted protrusion that will prevent you from inserting the pin easily. If this should happen, you can reposition the crimpers & crimp it back into place.

To see a video of crimping in action [Click Here](#).



Okay! The pin is crimped on & stronger than a soldered on pin. Time to insert it for use. You simply slide it in from the back of the connector into the position you want it in until it snaps the barb (locking tab) into place to prevent it from pulling back out.

On the right in Pic. 5 above are some of the more popular means of removing a pin if you need to change out a wire or if you simply installed it in the wrong position. The idea is to slide between the back of the pin & the housing to press the barb inward & thereby releasing the pin to be pulled out. Once you have removed it, examine the barb to see if you have bent it back flush with the back of the pin. If you have, you can use a bobby pin to push on it from the inside of the pin, outward, again, restoring it to use.

I guess that just about covers pins, but what is "C" used for? "C" is used for insulated connectors such as the .187 QDs (quick disconnects) used to slip onto the control panel button & joystick switches & the .250 QDs used for most coin switch connections.

The HT-1921 crimpers also is a wire stripper & cutter & has provisions for cutting bolts to size from 4-40 to 8-32, which I use to rethread some of those tough 4-40 bolts that just don't want to start in their threaded holes after years of use.

The big advantage of Molex connectors over solder eyelet connectors is that you can change a wire if need be. On the SEs a broken pin usually means you have to change the whole connector out. All of the parts mentioned are available [here](#):

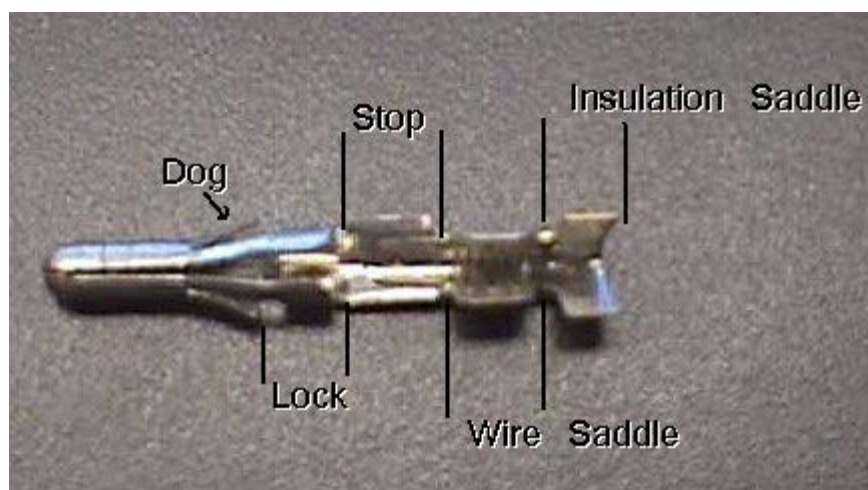
[Connectors/Pins/Crimpers](#)

Happy Gaming.....

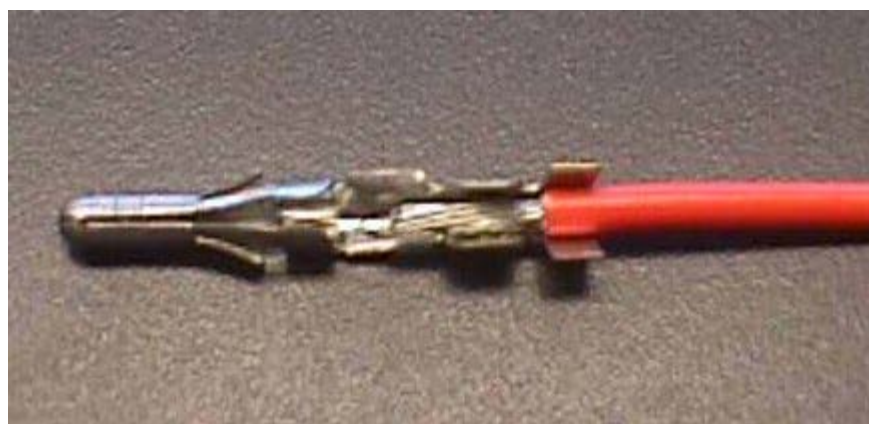
Crimp Quickie

by Bob Roberts

Seems a lot of newbies are having trouble with crimping pins & socs, so here's a quick note on it & links to other germane pages.



When crimping each saddle you need to be sure you are on just the specific saddle especially when crimping down the stripped wire saddle. If you go over just a bit your crimper saddle will crush the stop ears allowing the pin or soc to just push right on thru the connector rather than locking it in place. What holds the pin or soc steadfast in place when you push it into the connector is the stop on the back side & the dogs on the front side. When you push the pin or soc all the way in you'll here a little click & that is the dogs snapping open to lock them in place.



Your stripped wire can be longer & go past it's crimp saddle without interfering with the process. The saddles are longer than need be & just one hard crimp will more than likely just smash it down flat & you don't want that. Many a newbie has done that & then another no-no to try & correct it... soldering them! You never use solder on crimp pins/socs. The first step should be done with the largest saddle on the crimping tool... just applying a moderate pressure while looking at the pin/soc saddle to see it begin it's roll motion back toward the center. Now that they are started you can go to the smaller crimping tool saddle to finish the crimp roll & rather than one swift movement you get a much better crimp by rolling back & forth with moderate pressure in three positions.



Your finish crimps should look like the above & be rounded rather than flat & with the stops still butterflied outward to secure the pin/soc into the connector housing.

Using the [HT-1921 crimping tool video](#).

Crimping & extraction on the [Crimp Mystery Page](#).

Happy Gaming...

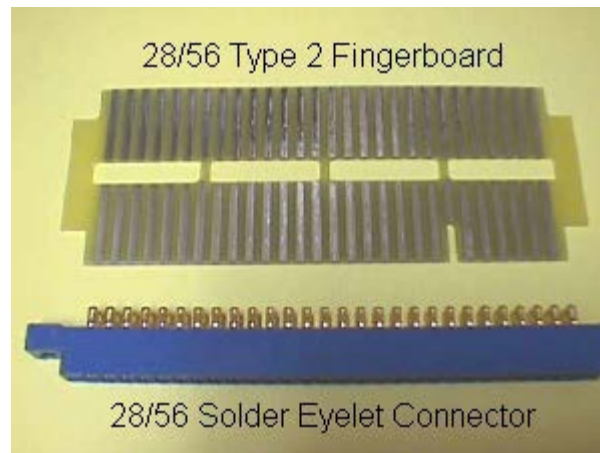
Pac DC Harness To JAMMA Board Adaptor

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By Bob Roberts

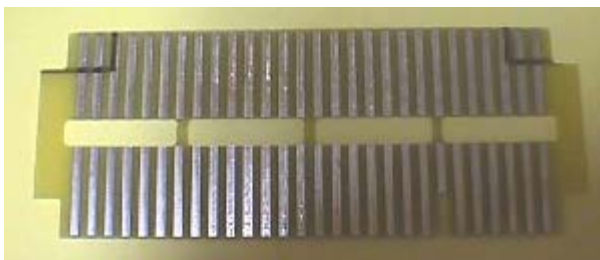
One of the things I've been doing via email over the years is explaining how to use Ms Pac-Man cabinets to test JAMMA boards. I dread the thought of someone hacking up a Pac cab into a JAMMA, so I've been reluctant to put it up here before now, but there are several people asking how to do this at this time & they want to be able to play the vertically oriented JAMMA bds. Darren of NY was the first to ask me to go through this & I had promised him to map this out for use with an old control panel or a replacement panel set up for JAMMA that could be swapped in & out with the Pac control panel. I've been working at this project for awhile now... 15 minutes here & 30 minutes there... and it's time to post it, keeping my promise.

Let me preface this by saying that this is NOT for a Pac or Ms Pac cab with original wiring utilizing AC power & the on-board DC power supply. This is to be used with a new DC harness or a game that has been converted to a switching power supply.

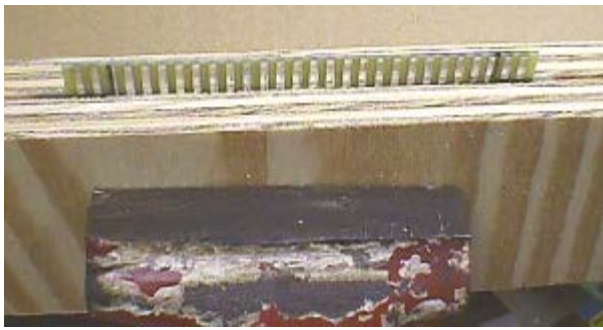
I'll start with a step by step & y'all can let me know if I wander off course :-)



The basic needs for this project are above if all you intend to do is test Jamma boards to see they have good video & audio. The type 2 fingerboard will have to be cut down to match the 22/44 position harness connector.



You'll need to cut 2½ positions from either side on the unkeyed edge & you can mark it out with a felt pen. Although this is not the way I usually do these things, I am going to do this one with basic tools that should be found in any hobbyist garage or tool box. Feel free to improve on this with whatever tools you have on hand.



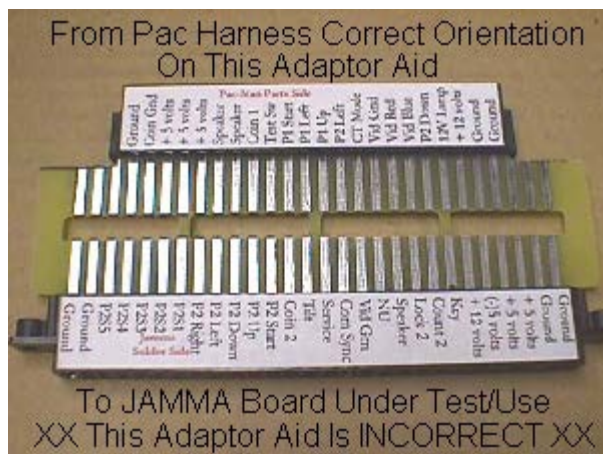
I placed the fingerbd between two scrap pieces of plywood aligning the marks with the top edge & tightened them into the vise. I figured this would not only protect the fingerbd, but it would also serve as a cutting guide. I did the two vertical cuts first being sure to leave half the trace of the third position on the fingerbd. If this proves to be too wide when you go to insert it into the harness connector, you can take a little more off each end for a proper fit with sandpaper or a file.



Using the plywood to guide the hacksaw the horizontal cuts were made. Next I tried an old previously cut off Pac edge connector on the fingerbd & found it was a tad too wide for the connector to slip on. I used the file pic'd below to trim up the two sides leaving approximately 1/16" of the trace on both ends. It's important to do this equally to keep the pins in the harness connector perfectly aligned with the pads on the fingerbd.



I placed my adaptor aids on the fingerbd below, but as you can see, the solder side of the JAMMA connection ends up on the wrong side & needs to be flipped 180°.



If you flip it over then both parts sides are on top & your wiring will come out correct.



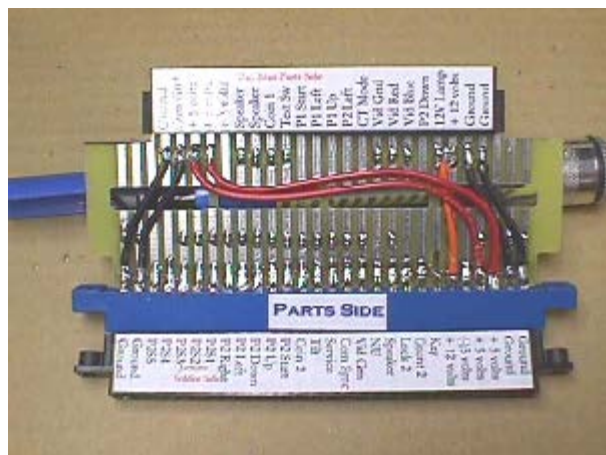
I realize that not everyone has my adaptor aids, so I'll tell you how you can get around this the way I use to years ago in the pre-adaptor aid days. You can take white adhesive tape & tape over the connector edges in lieu of the aids & then enlist the boss to hand print each connection on the tape. I say the boss because she'll usually have better printing :-)



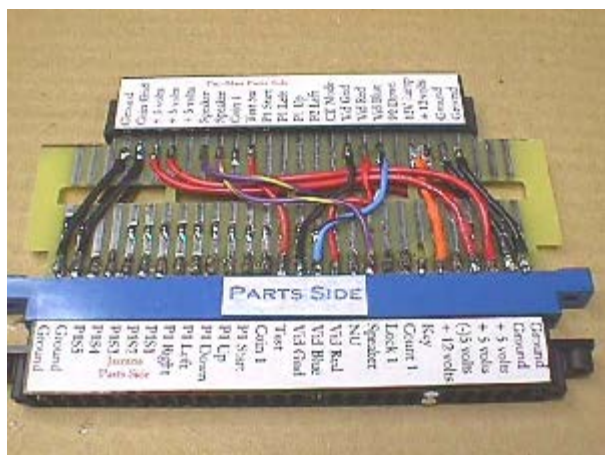
Since not all positions are going to be used on either side of the fingerbd I decided to mark the ones that are used with solder. The Pac harness side will be used anyway, but the JAMMA side connections will go straight to the solder eyelet edge connector, but these little solder markers will not interfere with anything. You may elect not to use them on the JAMMA side if you are confident in your skills.



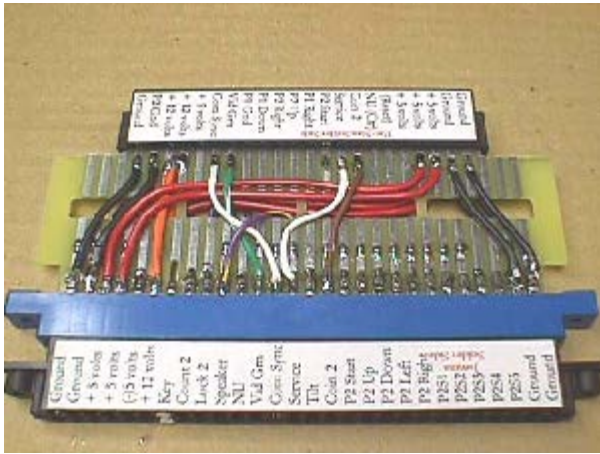
Next tack the 28/56 solder eyelet connector onto the JAMMA side of the fingerbd the same way as described in all the adaptor instructions making sure that it is perpendicular as shown on my Pacpower Adaptor Page [here](#). If you are using the adhesive tape to label your connections you won't want to mark this with a "Parts Side" label until you are finished. Also, let me mention :-(before I forget)-: that A: You do not want to leave the adhesive tape on these pieces overnight... the least possible amount of time is best... & B: When you remove the tape you will need to clean wherever you had it with rubbing alcohol to remove any adhesive residue.



Now it's time to redirect all the power connections from the Pac DC harness input over to the proper JAMMA power inputs using 18 gauge wire. It is best to color code wherever possible.... in this case red for 5VDC, orange for 12VDC & black for ground. After you do the parts side you can flip it over & do the solder side which should mirror the wires on the parts side.



The other lines that need to be redirected from the Pac DC harness are the video connections, any coin door connections you are using and the speaker connections.... all 20 gauge wire.



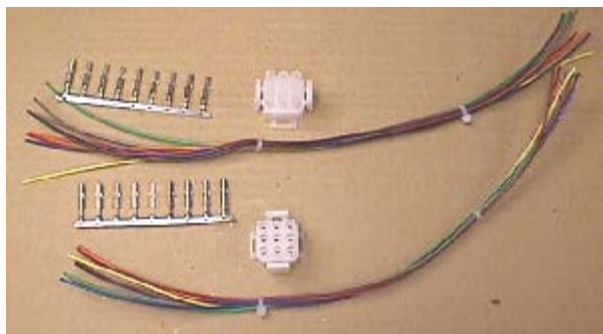
Once all these lines have been redirected and all you want is a simple JAMMA bd tester for basic go/no go conditions... you're finished... label the parts side & you can place the adaptor on a JAMMA bd you want to test & plug it into the Pac DC harness & fire it up.... & if you don't want this to be a literal firing up, make sure you always carefully go over your connections to be sure you rerouted properly.

If you want to utilize this with an interchangeable control panel, or if you want to make up a control box to extend your JAMMA testing, you can continue below, where we will be making use of the remainder of my solder markers on the JAMMA side of the adaptor in the pic above.

K.... to pull off this control panel wiring we'll need to go from the solder-marked control panel positions on the fingerboard to the actual controls on the secondary control panel that you are making up in a JAMMA layout... or control box, as both would be treated in the same manner. It's easier to have the lion's share of the wiring with the control panel & a short interconnect harness affixed to the adaptor, so that's the way I will map it out, but you can use connectors on both ends leaving the lion's share of wiring in the cab itself. Of course, you can make it in reverse if you want or be creative in whatever way you want. I'm going to use Amp 9 position connectors, but you can use any brand of connector or one with more positions than just 9 if you want.

I'm going to assign wire colors now to make the wiring simple & I'll put them in here for you to use if you choose to do so. I'll do this in same-color wiring that can be done with the 10 basic colors & make it very easy for tracing or comparison troubleshooting later on. Every wire color on player 1 controls will correspond with a like color on player 2 controls.

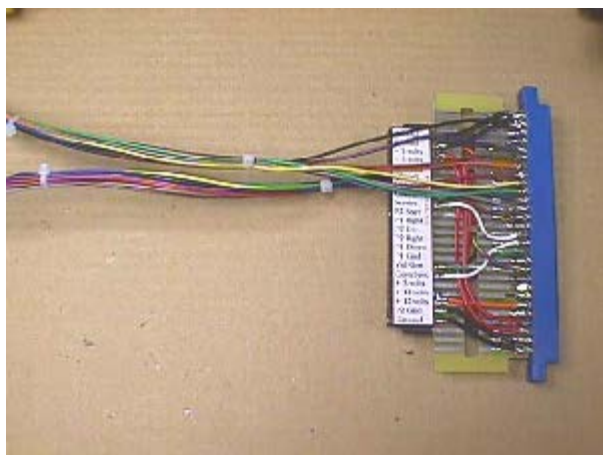
Bob's JAMMA Control Panel Color Code			
Assigned Wire Color	Amp Position	JAMMA Player 1	JAMMA Player 2
Gray	1	1 Start	1 Start
Blue	2	2 Up	2 Up
Green	3	3 Down	3 Down
Yellow	4	4 Left	4 Left
Red	5	5 Right	5 Right
Orange	6	6 Switch 1	6 Switch 1
Brown	7	7 Switch 2	7 Switch 2
Violet	8	8 Switch 3	8 Switch 3
Black	9	9 Ground	9 Ground



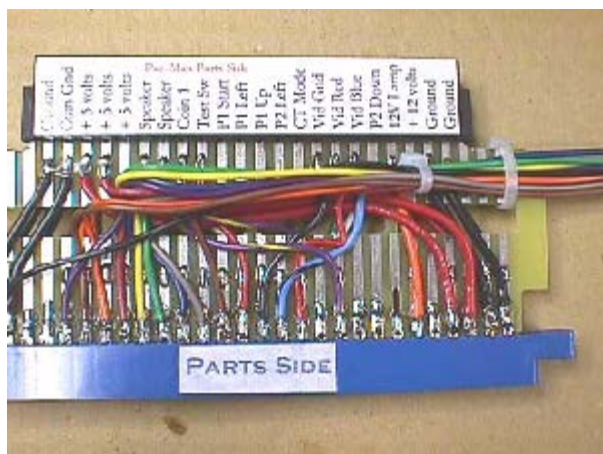
You'll need to cut 2 bundles of the nine colors of 20 ga wire 12 inches in length & cable tie each bundle. Next is to crimp the sockets on one end of each bundle... 18 sockets. Then take the 2 Amp plug halves and insert the proper color wire in each connector position number following the color code chart. You'll find the corresponding numbers stamped on the back side of the plugs... you might need a magnifying glass:-(There is a rib on the exterior of one corner of the connector that signifies position 1 to get you in the right ballpark.



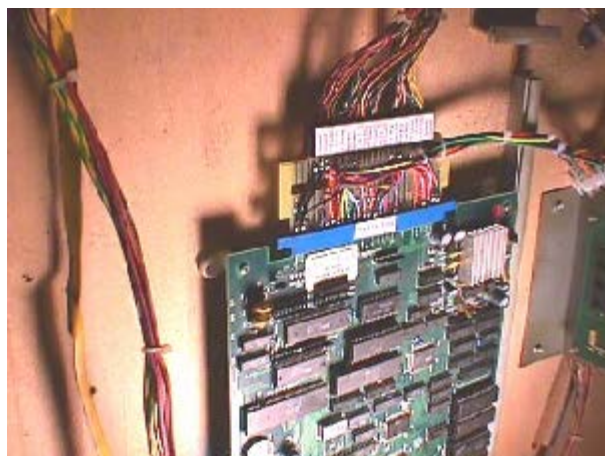
Label one connector #1 & the other #2 & then strip back a quarter inch on each wire in both bundles & tin them with solder in preparation for soldering them to the adaptor on the JAMMA side.



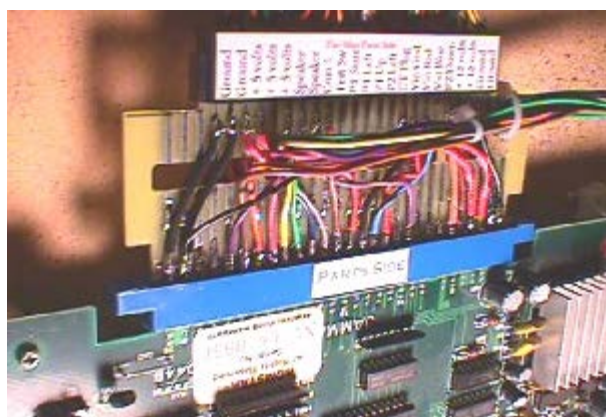
Solder the #1 control harness to the JAMMA parts side of the adaptor mating colors to pinout following the color code chart. Flip it over & do the same on the solder side for player 2 controls.



Now you can put a 90° bend in the wire just above the soldered connections & head it toward the front of the cab on both sides as pic'd. Cable tie them together after they leave the fingerbd.



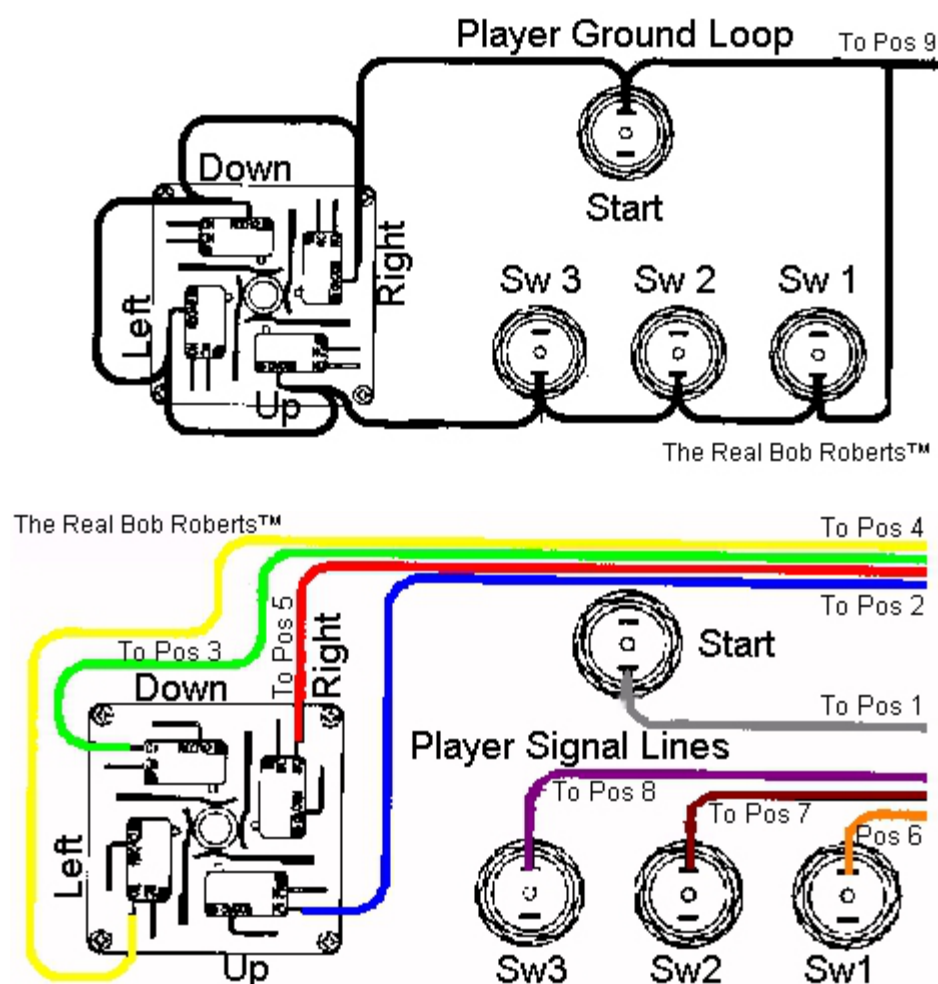
Here's a couple pics of the adaptor on a JAMMA bd sitting in my old clunker Pac cab & you can see that the labeled plugs on the right are ready for mating receptacles/caps from the control panel to be plugged into, routing wiring to proper destinations.



I don't have the time to do the control panel & snap pics, but there must be a hundred, or so, pages on how to do that up here in netland. Basically, in this case, you'll want to make up 2 more harnesses approximately 3 feet in length using the same 9 colors of wire... this time crimping on the mating pins & inserting them into the proper positions on the mating receptacles/caps following the color code & cable tying them. You can double check by plugging the harness into the adaptor to see that you have the same color going into & out of each position. Remember, this is just a break plug to interrupt each line, so they all have to match up when the connector is plugged together. Mark them as before... #1 & #2... and if you are joining the two into one harness to the control panel you'll need to mark the CP end of one bundle with tape (around all 9 wires) & mark with the appropriate number for player 1 or player 2. You can mark both bundles if you are in doubt about anything. This will prevent you from crossing any of your same color wires to the wrong controls.

Terminate each bundle into the appropriate player controls with .187 QDs as pic'd below. The player 1 & player 2

should look like twins when both are wired up, so I have only pic'd one side.



I'm going to put together a basic kit for stopping with just a test adaptor & a deluxe kit to include the necessities for hooking up a control panel & I will post both here, as well as, on the Parts Page. Wish I had time to do this in greater detail, but I think these essentials should help you get the project completed.

The basic kit for building a DC Pac harness to JAMMA bd tester will include the following for \$8.50.

- 1 Bag Scrap Wire
- 1 28/56 Solder Eyelet Edge Connector
- 1 28/56 Type 2 Fingerboard

The deluxe kit for building a DC Pac harness to JAMMA bd with control panel termination will include the following for \$17.00.

- 1 Bag Scrap Wire
- 1 28/56 Solder Eyelet Edge Connector
- 1 28/56 Type 2 Fingerboard
- 1 10x10 20ga Wire Pack
- 2 Amp .084 9 Pos Connectors
- 18 Cable Ties
- 18 .187 Quick Disconnects

Just a reminder... this is NOT to be used with the OEM AC Pac/Ms Pac-Man wiring harness. To attempt to do so will

feed AC voltages onto whatever JAMMA bd you plug into it rendering it ready for trash pickup :-(

Happy Gaming...

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Defender Rom Board Layout

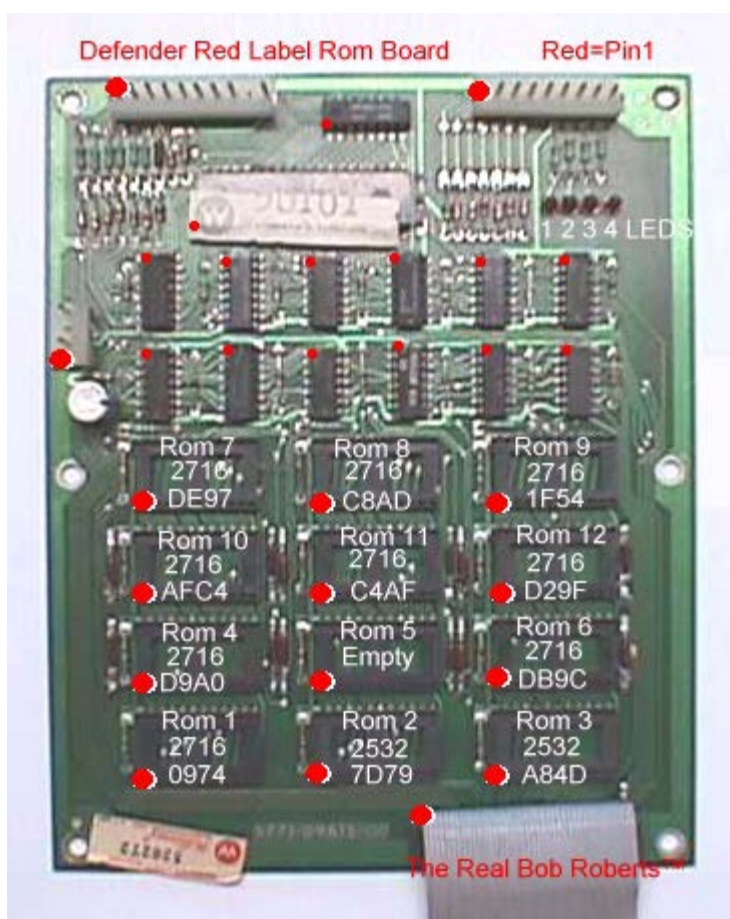
by Bob Roberts

The Williams rom boards seem to pose a problem for everyone, in some manner or another, so I thought I would put this pic up here to hopefully answer a lot of repeat questions.

I guess it is no wonder that it is a stumbling block for some, since the labels are often times upside down or worse, intermixed from previous repairs with eproms from other games with the labels in the opposite direction, and from new eproms with their different looking labels, regardless of direction. Then there is the row deviation placing 10/11/12 in the center, and I don't know how many times I got games in with the roms simply out of position....sometimes with the whole field inverted, I guess due to installing the roms without realizing which way was up.

Which way is up? That's another question still asked frequently, tied into.. I want to know which way to read the four LEDs to locate my problem or simply which LED is number one. The picture below should answer all questions regarding layout. All pin 1 positions are marked with a red dot, and the top line on each rom is it's position, the center line is the type of eprom used, and the bottom line is the checksum for that rom.

I get asked about the difference between the red label & the white label with the red stripe quite often. It is my opinion that there is no difference. The checksums are the same and the white & red stripe labels on various boards, show no particular pattern of striping from one chip to next, let alone from rom board to rom board. On that basis, I drew the conclusion that they simply didn't have the red labels available at the time of release in 1980 and striped them with a red marker of some sort. When the 1981 red labels turned up on the scene, I read them into my programmer & ran the comparison test on them, only to find no differences.



Happy Gaming.....

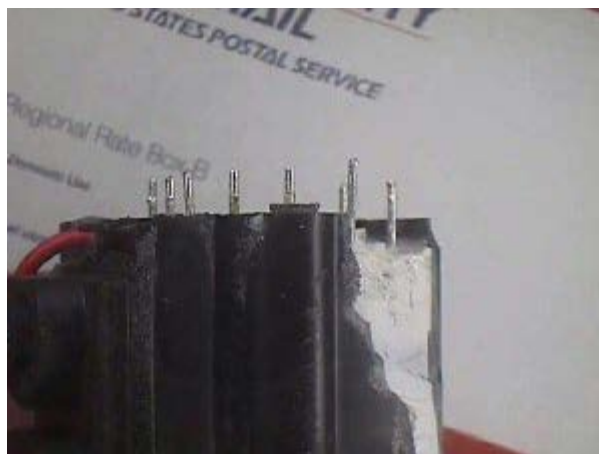
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Defective Flyback?

After a 50 year search I may have found a "defective" flyback... well, someone else found it for me. I often wondered how could anyone screw up a coil of wire.... run out midstream & add another piece with a slip knot :-() Well this particular flyback did not ring out on pins 3 & 4, so I decided to find out why.



I shaved the casing down a sliver at a time until I could see inside. What I found was that one end of the coil had snapped off it's terminal post & when touching it the winding did ring out. I removed the 2 terminal posts & cut away a little more to expose the winding wire which looked like pieces of thread. Best guess is that this is 32 ga wire or smaller.



I took the pic above thru a magnifying glass to try to capture the ends of the winding & they are still not visible. I'm sure that they ring out the windings at the manufacturer, so that leaves a possibility of it snapping during shipping or in handling it for installation. I know I have been guilty of bending the pins to fit the footprint better with a pair of needle-nose pliers myself & after seeing this I'll be more careful in the future. The reason I say this may be a factory defect is that even if it rang out good before shipping it may have been too taut to the terminal post making it prone to breaking, although this is the only one I've ever seen. One would think if a defect were to be in a specific component it would run through the whole batch made at that time.... akin to the peanut butter scare of a few years ago that effected the whole batch.

Degaussing

by Bob Roberts

No matter if you have one video game or one hundred in your collection you should have a professional degausser. If you own a cocktail table you already know that you'll never have good color unless you degauss every time you move the game or open the cab. If your purity is off from any external source... moving the game, opening the cab, being too close to another magnetic field, positioned too close to the beer cooler, the kids playing with magnets or the big kid playing with speakers... you'll need a pro degausser to clear it up in less than a minute.

On-board degaussers are fine for a small splotch obtained by transporting the game, but even then it may take an extended period of time to clear it completely. This type of degausser is only active for seconds upon completely cold power ups of the game, so it may take many cold starts to clear the small splotch & and that, it may never clear it as much as what using an external pro degaussing coil would achieve.

There are many of the small "Tonka Toy" twenty dollar versions of a real degausser on the market today & they will work as well as the on-board degaussers, but are nowhere near powerful enough to produce perfection. A professional degausser will actually hold these in the center of them much like a gyroscope. Yes, there are many ways to clear up a small impurity unconventionally such as using a speaker, or other permanent magnet, an electric drill, a soldering gun, an old 8-track demagnetizer, bulk eraser or any number of other ways of introducing a magnetic field that you can work. These type of things are not permanent nor correct... just a temporary quick fix to get by & often times the layperson will make the situation worse rather than better.

I hear the impurity symptoms stated in many ways... the lettering on my game changes color halfway across the screen, the bottom of my pic has wrong colors, I have a purple spot in the corner the size of a baseball... and indeed, magnetizing any portion of the screen will give you dramatically different results. Here's a few pics:



Using a pro degausser is as simple as it is effective. You simply hold the power button in and starting a few inches away from the screen slowly move it in a circular motion while backing away from the screen five or six feet & release the power button.

You can view it below being cleared in seconds... remagnetized & cleared again.

[Clip of degausser in action.](#)

Don't get too excited... I bought a \$25 Jazz from Big Lots to do this & you can tell ;-)

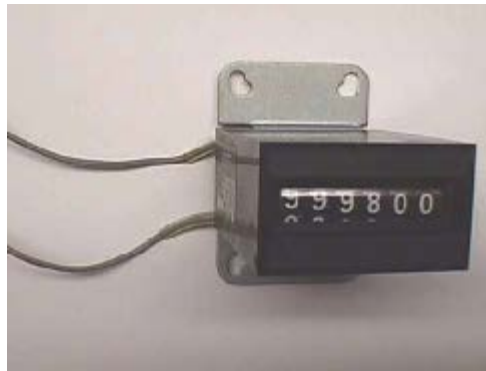
Happy Gaming...

- Diode! Which Way Did It Go! -

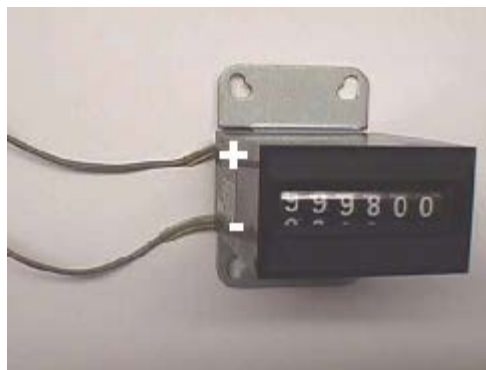
I "hear" this a lot & it's usually accompanied by ... I just want to know which way is the correct way to put it in & don't care what it does, be it blocking, single, half or full wave rectification, or if it's just in there to add to the weight of my game! Here's a couple examples, maybe oversimplified, that should help you determine the correct way on your own. First I'll paste an excerpt from the WMs Battery Conversion Page that might prove to be of some help:

This will work in many other cases, but beware that you cannot just drop this in place of a ni-cad without defeating the charging system. This can be done by installing a blocking diode in the + line. I'm quite frequently asked how one can tell which way to install the diode. I think it is easiest for a newbie to think of the cathode stripe on the diode as a gate in the front yard fence that only opens outward as you are leaving your home, with the body being your walkway, of course. No one can walk up to your gate & pass through to enter your home, but you can walk down your walkway (diode body) and out through the gate. A diode with the complete symbol imprinted on it will have an arrow with it's point butted up to the cathode band signifying the direction of flow. If used as a blocking diode for a lithium battery you would want the cathode on the end furthest away from the + terminal, thus allowing the flow down the walkway to the components, but blocking at the gate any flow back towards the battery.

A common app that may even need 2 diodes would be coin meters, if used.



Your meter may have a diode installed inside to prevent spikes, called a clamping diode, and if it does, you'll find a + & - sign on the side where the wires come out as pic'd below.

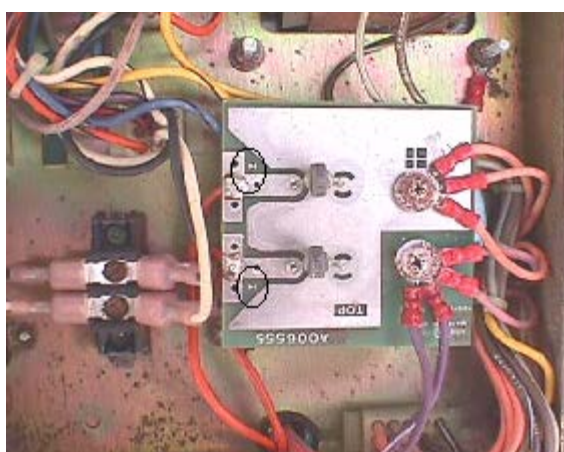


Most meters with internal diodes will have color coded leads to aid in identifying polarity with red for the + side & black for -. The + side will connect to your voltage source, which should match the voltage rating found on the meter, as well. The - side will connect to your pcb's circuitry for pulsing the meter low (ground).

If your meter does not have the internal diode you can put your own across the 2 leads. Since you have no polarity at this time, it makes no difference which way you install it, but once installed, the cathode (banded end) becomes the + side & must connect to the power source. The other side will go to your drive circuitry of your pcb or whatever else you may be using.

If you want to install a coin meter & your PCB doesn't have any drive circuitry, you can connect it directly to the coin input circuitry. As your coin switch closes to pulse the input for your PCB, it also pulses the meter. This will work well with a 5 or 6 volt meter, but if you are using a 12 volt meter you do not want this 12 volts feeding back into your circuitry on your pcb & damaging it, so you can use another diode to prevent (block) this from happening. If you install a diode in the coin switch line coming from the PCB in the direction of the arrow with the banded side (cathode) towards the meter & coin switch it will block the 12 volts from feeding back into the board circuitry. Sound familiar.... it's the same blocking action used on the Tron/MCR battery conversion to stop the on-board charging system from feeding into the lithium battery.

Here's a recently asked Q that will fit right in here, about replacing the diodes on an Atari xformer assembly for an Asteroids.



From the pic you can see that the older ones were not plainly marked with a band for the cathode side. They have a very thin pic of the symbol depicting the direction of flow on the side, but it is quite often worn away over time. In almost every instance you will find the symbols stamped on your PCB. In the case of this small PCB that mounts to the "Big Blue" capacitor, the symbols are very small themselves, so I circled them above. If you look closely you'll see the entry arrow butting up to the cathode band which faces the capacitor. This board with the 2 rectifiers forms a conventional full wave rectifier. Later Atari assemblies came with a full wave bridge rectifier. You might also note the + symbol on the pcb signifying the positive side for the Big Blue capacitor.

K6100 Additional Parts Kit

August 2006

Recently I was sent an email asking for clarity on the K6100 additional parts kit. The composer also sent a few bits of data that he found on the net that simply were not true, so I thought I'd create a few spare minutes to quickly clarify this a bit.

As far as I can follow this story via the net, one night one of the hobbyist decided to do a marathon of repairs to his K6100 chassis' & took notes he thought pertinent to his findings & posted them on his web page. He later turned them over to another hobbyist who did the same thing & added all of his own personal observations. Now some time later a third hobbyist made his own observations & upgrades he thought would improve his K6100s, leaning on the two previous collections of thoughts along with other hobbyist's comments. Lots of hobbyist's latched onto this new & improved list that they found on a website.

After a few years of hobbyist doing these "improvements" I started getting requests to put these parts together into a kit. The common threads were one, the parts were hard to find, & two, the ones they did find were in multiple locations making the shipping costs far outweigh the cost of the parts. I resisted & suggested they try some of the established kit makers.

In Dec 98 I got another email CC'd from a half dozen hobbyist telling me that they could find no one to put together a kit of these parts & asked if I wouldn't reconsider. I asked around about the kits trying to see why no one wanted to put them together & the general consensus was that since the kits were not something that was a product of WG, or their engineers, that they were uncomfortable with supplying them.

I was still reluctant to put the kit of parts together, for some of the same reasons, but after many emails asking for various components of the kit & with more suggestions of just gathering up the parts, adding a disclaimer & making them available as is... just a kit of parts... I finally caved mid Jan of 1999 & did just that.

I've been supplying the kit of parts with the disclaimer since that time & although I do not agree with a lot of the recommendations, they had been used prior to my knowledge of them & had not done any harm and, in fact, everyone was convinced they improved operation.

The one change that I made was because whoever read the OEM diodes D100-D103 obviously was not familiar with them & underrated the replacements by a good deal! This was also mentioned in the recent email for clarification & this error was attributed to my kits, which is not true, and the suggested replacements are also underrated! I'll paste the quote here:

"The other thing to be careful of about Bob's ultimate 6100 cap kit is that the diodes provided for the deflection board are wayyyyyyyyyyy under-rated. They get burned up to a short in a matter of minutes which then takes out other components in the LV section. I use 1N5408."

This is obviously written by another person who does not know how to read diodes and, although I believe these 3 amp diodes to be sufficient electrically for the particular circuit, they are still underrated vis-a-vis the mfr's specs. As for using the 1 amp diodes recommended by the "list", although they are seriously underrated, IMHO they would not be the cause of other components kicking the bucket, but rather just the opposite... the other obviously bad components would kill the underrated diodes upon powering up or soon afterward.

Here's a current excerpt from the "improve the K6100" list:

D100 1N4007 (NTE125) diode Replaces 5A2 (1N4005/NTE116)
D101 1N4007 (NTE125) diode Replaces 5A2 (1N4005/NTE116)
D102 1N4007 (NTE125) diode Replaces 5A2 (1N4005/NTE116)

D103 1N4007 (NTE125) diode Replaces 5A2 (1N4005/NTE116)

"Note the new 1N4007 diodes used at locations D100 to D103 will be considerably smaller than the 15 year old original diodes. Don't worry about this; new products are smaller, yet more durable."

Well... where to start... yes, worry a bit, the 1N4007 diodes will be considerably smaller than the S5A2 OEM diodes & the reason for that is not shrinking technology, but rather the fact that the 1N4007 diode is only a 1 amp diode vs the S5A2 5 amp diode. Incredibly, the author has listed the OEM diode above, 5A2, and the very part number is the key to it's value.... 5Amp200V.

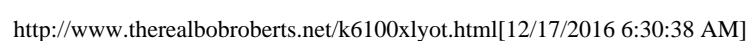
The 1N4007 diode is one of a series & not read so readily. It is one of the most common rectifiers (diodes) in use in electronic apparatus as it can safely replace all lower voltage rated ones in it's series. I'll sidetrack here just a tad to post the ratings of the series:

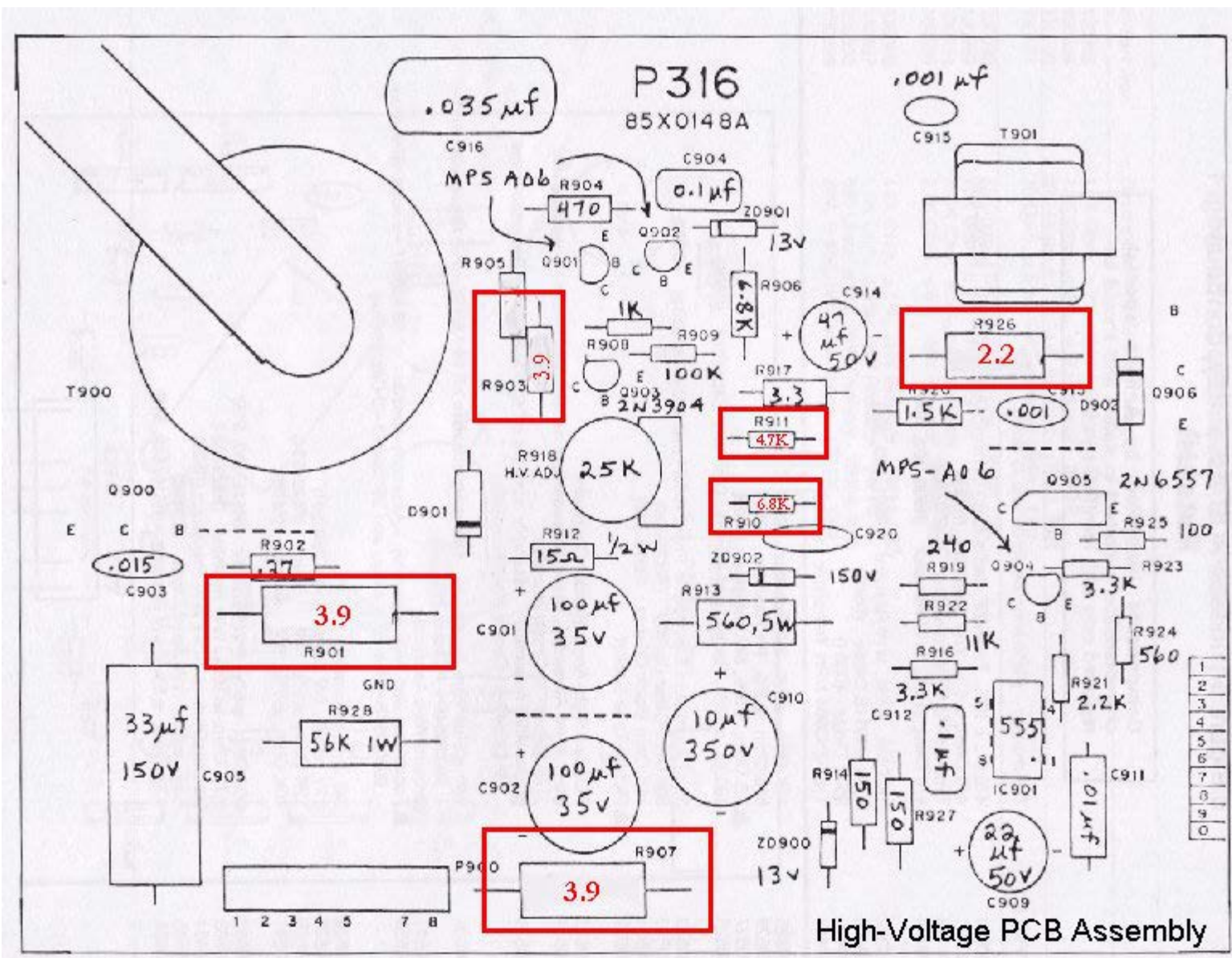
1N4001 1A 50V
1N4002 1A 100V
1N4003 1A 200V
1N4004 1A 400V
1N4005 1A 600V
1N4006 1A 800V
1N4007 1A 1000V

When it comes to physical size of diodes they have been pretty consistent throughout the years up until the advent of SM technology, so you will pretty much find that a 1 amp will be larger than a 500ma & a 3 amp larger than a 1 amp... so on & so forth. There are exceptions to every ROT, but this one is fairly consistent. On the other hand, capacitors & resistors have been ever shrinking over the years. Get out the magnifying glass!

The diodes supplied in the Additional Parts Kit are 6A2 or higher, or equivalent, depending on what is available at any given time. The 6 amp diodes are what you might refer to as an upgrade as they are able to handle a higher amperage.

One last thing mentioned in the recent email was a request to layout these parts, so I will attempt to place them on the layouts below before I leave here to run over to my attorney's office to see if he can recommend a better grade of motor oil for Alice's Ford van.





Donkey Kong Switcher

by Bob Roberts

Updated 10/20/01

I get asked this all the time & usually paste this answer from my files, but I thought it was time to put it up here where I don't have to keep pasting it all the time.

I want to rip the power supply out of my Donkey Kong & put in a new switcher and need to know how to do it the easiest way. Why on earth do that, when you can have the best of 2 worlds.

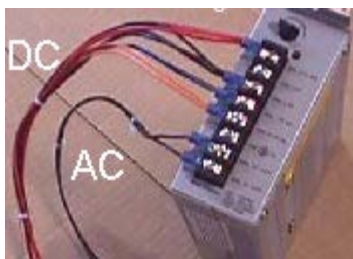
Who knows what a DK will be worth 10 years from now.... Here's how I would attack installing a switching power supply to preserve the integrity of the machine.



I would get 2 sets of Molex .093 12 position connectors & 2 sets of Molex .093 9 position connectors & install one set in each line...the ones that go to 9P & 10P on the power supply. These would be straight thru line interrupt plugs & the system would still operate as designed with a good PP-7B linear PS. The 9 pos for 9P & the 12 pos for 10P. I would install them about 12 inches down the line from the original power supply. When interrupting any lines, or when wiring up a new game, the best way to install connectors is to always put the receptacle portion, with sockets, from the power source. This would be from the AC in...from the DC power supply....from the game pcb to video in & etc, always working away from the source & leaving the pins & plugs for the passive connections. The reason for this is fairly simple in nature, you

want the source to be fully insulated & not exposed to an accidental shorting, such as what could be done with a spare pin falling into the plug/pin portion of the connection...hot side...smoke, smoke, smoke...passive side, not a problem since that side is never hot when the connection is broken.

So, the top set of receptacles in the pic to the right, will terminate the wires from the PP-7B power supply & also the wires coming from the new switcher, while the ends of the wires going down to the game pcb will terminate with the bottom passive plugs with pins which can handily plug into either source of powerPP-7B or switcher.



The second set of plugs going down to the switcher should be 15" to 18" long & I would opt to use the Jamma standard color codes for wiring, e.g., black = ground, red = +5 volts & etc, to terminate with spade connectors that will easily connect to the switcher terminal output screws. I recommend using 18 gauge wire for this new short run, as well. Since the AC input to the PP-7B is only 100VAC, I would simply unplug it while the switcher was in use, and for switcher power, I would tap into the 120VAC line just before the game's transformer input...so that it is a switch controlled AC input to the switcher. I would also put a 2 position Molex .093 connector in this AC input line for easy removal of the switcher. Remember that

the receptacle side will be coming from the transformer, so that when, or if, it is unplugged, there will be no existing shorting potential.

Done in this fashion, you would now have a PP7-B & a switcher & could plug to either one in less than a minute, being sure to unplug the unused power supply. If your PP7-B is in need of repair, you can run from the switcher until such time as you decide to repair the original or if you sell the game for some reason, the original hardware will still be in the

cabinet increasing the value of it.

As for how to terminate....

Connections From 9P CPU of PP7-B To CPU Bd			
DK Wire CC	New Molex 9	PP7-B P9	Switcher
Brown	1 ground	1 ground	1 ground
Red	2 ground	2 ground	2 ground
Orange	3 ground	3 ground	3 ground
Yellow	4 12 volts	4 12 volts	4 12 volts
Green	5 12 volts	5 12 volts	5 12 volts
Blue	6 5 volts	6 5 volts	6 5 volts
Purple	7 5 volts	7 5 volts	7 5 volts
Gray	8 -5 volts	8 -5 volts	8 -5 volts
White	9 24 volts	9 24 volts	9 not used

Connections From 10P CLK of PP7-B To Video Bd			
DK Wire CC	New Molex 9	PP7-B P9	Switcher
Brown	1 -5volts	1 -5volts	1 -5volts
Red	2 -5volts	2 -5volts	2 -5volts
Orange	3 -5volts	3 -5volts	3 -5volts
Yellow	4 -5volts	4 -5volts	4 -5volts
Green	5 ground	5 ground	5 ground
Blue	6 ground	6 ground	6 ground
Purple	7 ground	7 ground	7 ground
Gray	8 ground	8 ground	8 ground
White	9 5 volts	9 5 volts	9 5 volts
Black	10 5 volts	10 5 volts	10 5 volts

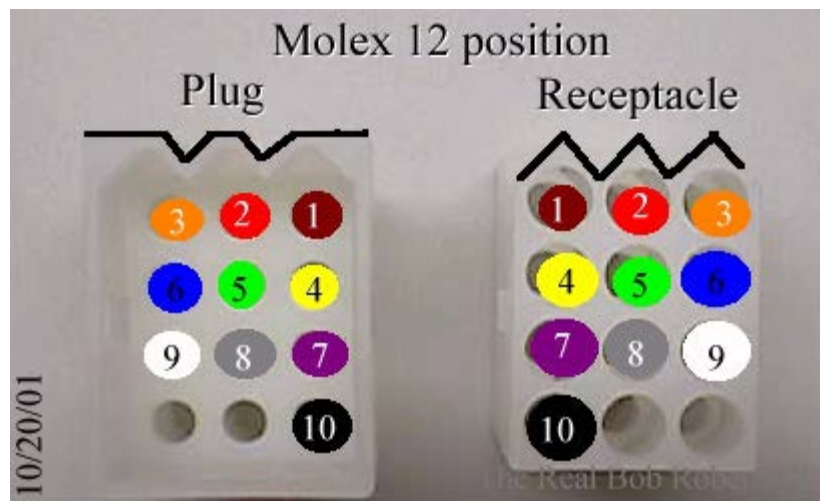
Modified 10/20/01 to include OEM PS harness color code.

Combine switcher wires P9 pos 4 & 5 to one spade for 12 volts.

Combine switcher wires P9 pos 8 & P10 pos 1-4 to 1 spade -5 volts.

Combine switcher wires P9 pos 6 & 7 P10 pos 9 & 10 1 spade to 5 volts.

Combine switcher wires P9 pos 1/2/3 & P10 pos 5/6/7/8 to 1 or 2 spades going to ground(s) on switcher.



Positions are numbered on the back of each, but are very small, so I will apply numbers & DK thru colors. Remember that you are looking at the mating ends and not the numbered ends that the wires go into. Good Luck

All parts for this project are available on the [Parts Page](#).

Happy Gaming.....

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Programming Eproms:Yikes!

by Bob Roberts

The year 2000 has arrived, bringing with it the advanced & less expensive technologies unthought of only a few short years ago. It is now affordable for an arcade game collector, operator, or nowadays, just about anyone in any field...since computer driven devices have begun their worldwide takeover...to own & use an eprom programmer. I think we are close to the time when we can actually say if it is a product that can be taken apart, you'll find an eprom inside!

In keeping with my nontechnical jargon newbie policy, I am not going into what an eprom is or does, but I am going to quickly address the issue of using this new found toy to program older eproms used in *Classic* video arcade games and other equipment from days gone by.

As more & more newbies obtain eprom programmers, a problem has arisen, and since I have been using good old faithful 1980s eprom programmers for years now, I'm not sure why, but I would guess that you need to setup your own profile with programming voltages for the various chips being programmed with these less expensive units. It must be something like this, as herein lies the problems. Many are asking me what the program voltage needs to be on certain brands, or asking what it should be for a house number/name... this is a number or name put on the chip by the mfger for the end user,e.g., Atari may have a 2764 that is labeled 137-093 or a Compaq computer may have a 2764 labeled simply as Compaq & with no other numbers or markings on it.

These are the people that know that some eproms require a different programming voltage. Now there are many who do not know this, and will therefore sometimes burn up a whole tube of eproms during their experimentations of burning (the in crowd's word for programming) the eproms, and this is exactly what occurs....the eproms are smoked & rendered unusable & ready for file 13.

As a general ROT, eproms from 27128A up to 27C160(16 megs) will program at 12.5 volts, but prior to those Jamma-era eproms the programming voltages varied widely. Beginning right here with the 27128, without the suffix *A* it's programming voltage is 21 volts! Hello! Newbie pops a 27128A in the socket & sets programming voltage at 21 volts instead of 12.5 volts, and we're having smoked chips for lunch! Where's that file 13 trash can?

Here's a chart for the most likely candidates for smoking, and I'll tell you how I handled this issue below, although it was never a problem for numbered eproms.

Programming Voltages	
2532	25 volts
2532A	21 volts
2732	25 volts
2732A	21 volts
2764	21 volts
2764A	12.5 volts
27128	21 volts
27128A	12.5 volts

Yes, this was a problem with house marked chips in the old days, as well. No one ever told me a way to tell the difference between the clearly marked eprom pulls and the sometimes no marking at all eproms that were mixed in the tubes. My first thoughts were to simply try it at the lowest setting to begin with. The results, keeping in mind that I use antiques & your results may vary, were as follows:

A) It programs at the lower voltage & the checksum verifies that it has done so successfully.

B) It programs at the lower voltage but there is a chksum error, in which case, I attempt to patch using the higher voltage. Most times this is successful, but occasionally the eprom will need to be erased & reprogrammed at the now known higher voltage.

C) The programmer tosses up some sort of erroneous error such as "device not erased", "chip not in socket", or sometimes it even says "wrong device selected", a good indication that you indeed need the higher programming voltage, which you can simply select at that time & continue on to a successful programming.

This has always worked for me & saved countless unknown eproms, regardless of whether the numbers simply faded away to nothing, or there was a house name or number on them.

I hope this saves a few more of the eproms that are slowly getting harder and harder to find.

Happy Gaming.....

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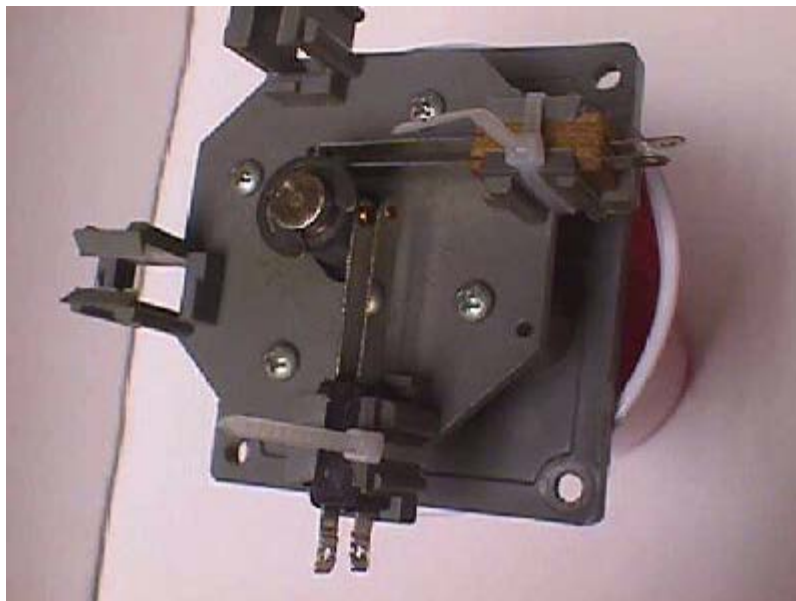
Fiber Leaf Switches

by Bob Roberts

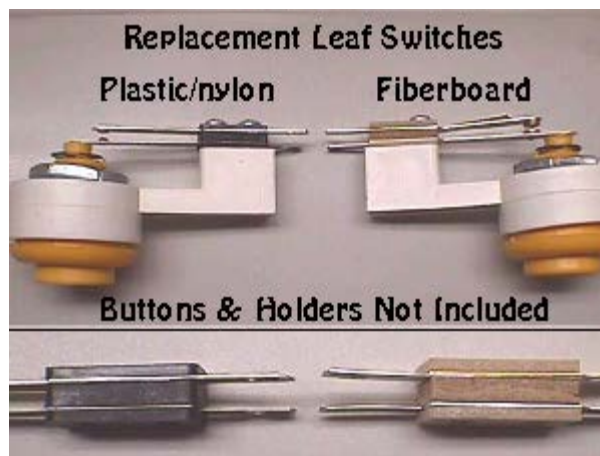
Fiber leaf switches have been around for many years & are much better than the molded versions of the Nylon era in MHO. I was working with them 50 years ago on electromechanical equipment that was nearly 20 years old at the time, so I guess it's safe to say they have been around nearly a century now. The blades are much stronger than those used with the nylon ones & should one break, or wear out, it can be replaced, unlike the disposable nylon type.

Since the nylon type for buttons & joysticks have been becoming extinct, we've been making up replacements in fiber. So far, 140 of y'all have agreed with me that fiber is a much better replacement by far... be it for buttons or, especially with the old Wico leaf joysticks.

The biggest problem with both fiber & nylon molded leaf switches comes from user abuse. They are gold flashed for the best contact & the gold flash blackens. This can build up over time & cause intermittent closing of the contacts. Then the user grabs a file or sandpaper & tries to clean them which in turn removes the gold flashing rendering them less than effective. The best method of cleaning for longevity is a simple business card or business card stock of any kind. On location they were often times cleaned with the card stock from a candy bar wrapper or a match book cover. It is only necessary to clean the very center where actual contact between the two blades is made... the outer parts can be left blackened without any detrimental effects.



Above are both styles of joystick leaf switches. This type used on joysticks comprises 2 of the shorter blades of the same length, whereas the button leaf switch has one short blade & one long blade which extends out to be depressed by the actual button when pushed.



I haven't had a chance to add the repair parts to the Parts Page yet, but I'll price them below in a pic. The blade thickness on these is .020 which is x-heavy. These were typically listed as follows:

- .008 Light
- .012 Medium
- .016 Heavy
- .020 X-Heavy

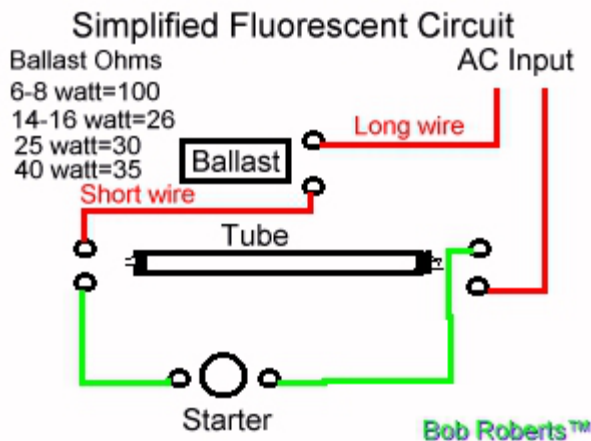


Happy Gaming...

Fluorescent Lighting

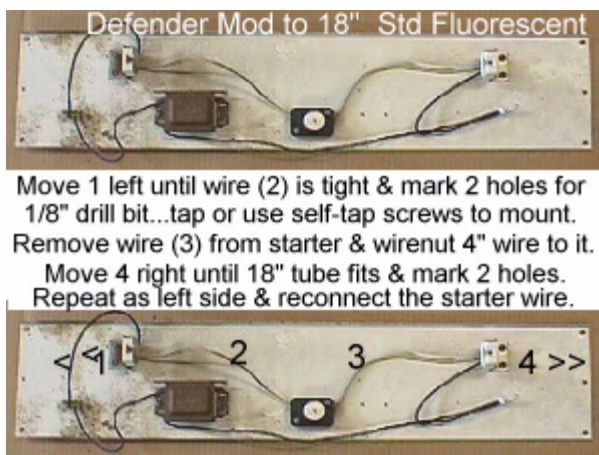
by Bob Roberts

I'll add to this in the future when I can squeeze out a few more minutes, but for right now I think these simple pics will be of some help to quite a few that have been asking how to wire up an old marquee light.



This is a simplified drawing that I did the best I could with. I'm no artist for sure! I looked in quite a few manuals for a layout similar to this, but most were poor pics or vague wiring diagrams. I hit some of the archives without any luck, so I drew my own blow-up.....yikes! I probably should have explained to my 9 year old grandson just exactly what I wanted to get better results than what I have achieved, but he is way up north in Alaska, & I'm stuck here in good old New Orleans about as far away as you can possibly be, so I guess they'll have to do :(

The list of ohms for each ballast is on the left and you should measure your's before putting a new fluorescent lamp in or else it may go poof instantaneously upon power up if it has a short.



The pic to the left is of an unmodified Defender marquee fluorescent assembly....I had to dig deep into the warehouse to find one that had not yet been modified. These were fitted with a 15" fluorescent tube from the factory deviating from the standard 18" tubes that are available almost everywhere & in most all games. In the early years I had made up a wood paneling template with the 2 sets of holes in it that were marked as to left or right & that you simply placed in each corner to mark the new holes needed to move the bi-pin sockets apart to accept an 18" tube. I

subsequently learned that someone was making peel & stick templates very similar to accomplish the same thing.

I always drilled the 1/8" holes & then used a tap to thread them to use the screws that are already present. Quite possibly the screws may make their own threads, but if not, self tapping screws could be used if you don't own a tap & die set. If nothing else, you could drill larger holes & use bolts & nuts to secure them. If you want the tube to be exactly in the center, you'll have to lengthen both starter wires, but looking it over with the one side lengthened as in the pic, it is not that far off & does not show once the marquee is installed.

The typical 18" fixture uses a F15T8/CW 18" fluorescent tube, the F15 signifying 15 watts & the T8 signifying the type/size tube...in this case a 1" in diameter as opposed to the

F14T12/CW 15" fluorescent tube at 14 watts and a T12 type which is 1½" in diameter. Ops use to ask for fat tubes or skinny tubes when ordering. These both use the FS-2 starters & the common replacement ballast that works with 13 thru 20 watt fluorescents.

As always, these ballasts, tubes & starters can be found on the parts page.

Happy Gaming.....

[Help Page Index](#) Big Bear's Bulletin Board [Site Index](#)

- Free Play -

Of all the ways I know of to make a game operate on free play, including cpu controlled, I think the best one is by using the 2 player start button which will work on a good 95% of games. Open your coin door & ID one of your coin switch wires that goes back to the pcb... not the ground wire that is looped to all switches... and then locate the wire leaving the player 2 switch & going back to the pcb. All you need to do is join these 2 wires together in some fashion. You can use [splice connectors](#) and a piece of 20ga wire to connect the two together. Getting fancy with this version, you could add an on/off switch on the inside of your coin door in-line with this circuit enabling you to flip the free play on & off when coin play was desired. You could go to the edge connector end of the harness to simply splice both lines together as they leave the pcb eliminating the need for a piece of wire. For all you shade tree techs... yes you can do it on-board, but you know I hate hacking up classics :-(

Once this is done, pushing the 2 player button will put up 1 credit to play a single game and pushing it a second time will start a 2 player game if desired. The reason that I prefer this method over the others, including dip switch free play, is that the games attract mode is left intact adding many years of life to the CRT's phosphor, i.e., less burn in on the screen.

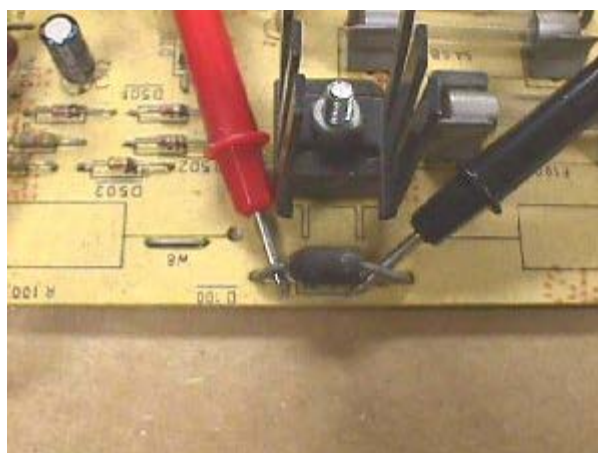
MY NOTES

In order to help more than one person at a time, I thought I would put my notes here on repeat requests. Maybe a one line answer or perhaps one of my novelettes... whatever happens to be called for at the moment. Since I lack the time to keep banging out html pages, I thought I would just scroll them in as they pop up in hodgepodge fashion as it takes very little time to move text to this format.

XY B&W Deflection Board Bridge

Here's a typical email pertaining to the bridge:

- > I need to replace a bridge rectifier that came out of my Asteroids.
- > The part number is KBPC602. On the side opposite of the part number it has 7924.
- > I saw this KBPC-601 Bridge Rectifier 6A 100V Pic 5 \$1.50
- > Can you tell me if they're interchangeable?



The bridge in the pic is just above the diode under test.

The key to reading bridges is in there part number. I've mapped out others onsite in various places, but I'll do this one right here separately.

The 602 = 62 = 6 amp 200 volts.

You need a bridge that can handle a minimum of 200 volts & more is better.

The 601 = 61 = 6 amp 100 volts.

While this may work for a while there is a chance of it busting at the seams because it can only handle up to 100 volts.

Before I get techs emailing me about this, in this particular case a 601 should work okay since this circuit is less than 80 volts, but 602's were used on the

chassis, so in general you'd need to meet or exceed OEM use.

The 604 = 64 = 6 amp 400 volts.

This one will handle up to 400 volts, so you have an increased safety factor of 200 volts over the part being replaced.

So... which one do you pick from the [Parts Page](#)?

The answer would be:

BR64 Bridge Rectifier 6A 50V-400V Pic 5 G05/Bally VJ248 \$2.00

I dropped the BR62 in favor of the BR64 to cover the most bridges requested with one stocking part.

As for the last part of the email:

7924 = 1979 week 24 the date it was born :-)

One final thing while here... many hobbyist request 8 amp bridges when replacing this one. There is no advantage to doing this that I can see & I wanted to point out that the physical size of the 8 amp bridge is larger & has larger leads, both of which make for a tiresome & ugly replacement in MHO.

Quick Note On The .156 Extractor!

The .156 pin extractor, aka JAMMA pin extractor, cannot be used to pry with.... as many have found out the hard way, including myself back in the day. I think I bought one with every order I ever placed with the "real" Wico.



You can see that the tip is very small, thin & not made for prying no matter how tempting. Usually the reason one is tempted to pry is due to the dog being hung up on the housing. The way to avoid this is to push the wire into the connector as though inserting it for the first time, while sliding the extractor in the opposite side. Then when you pull the wire & pin out of the housing it will glide right over the extractor preventing hang ups & practically falling out.

Should you break the tip off it is not hopeless... you can make a new tip with a grinding wheel. If you've bent the dog over on a pin & cannot get it out of the housing a precision screwdriver or a bobby pin can sometimes force it out.

FAQ - Do the B+ filters come in the cap kits?

No. There are no kits on the market that I'm aware of that come with B+ filters. This would make any kit cost prohibitive unnecessarily. Typically, a bad filter is going to give you a shrunk pic with the hula... maybe large black bars going thru the pic & possibly even a humming or buzzing will be heard. If you have one of those symptoms or just want to refresh your existing one you can purchase it separately.

FAQ - Xreference for parts on the Zenith built K7000?

Flyback - None

HOT - 121-1167-01 - 2SC4769 [2353]

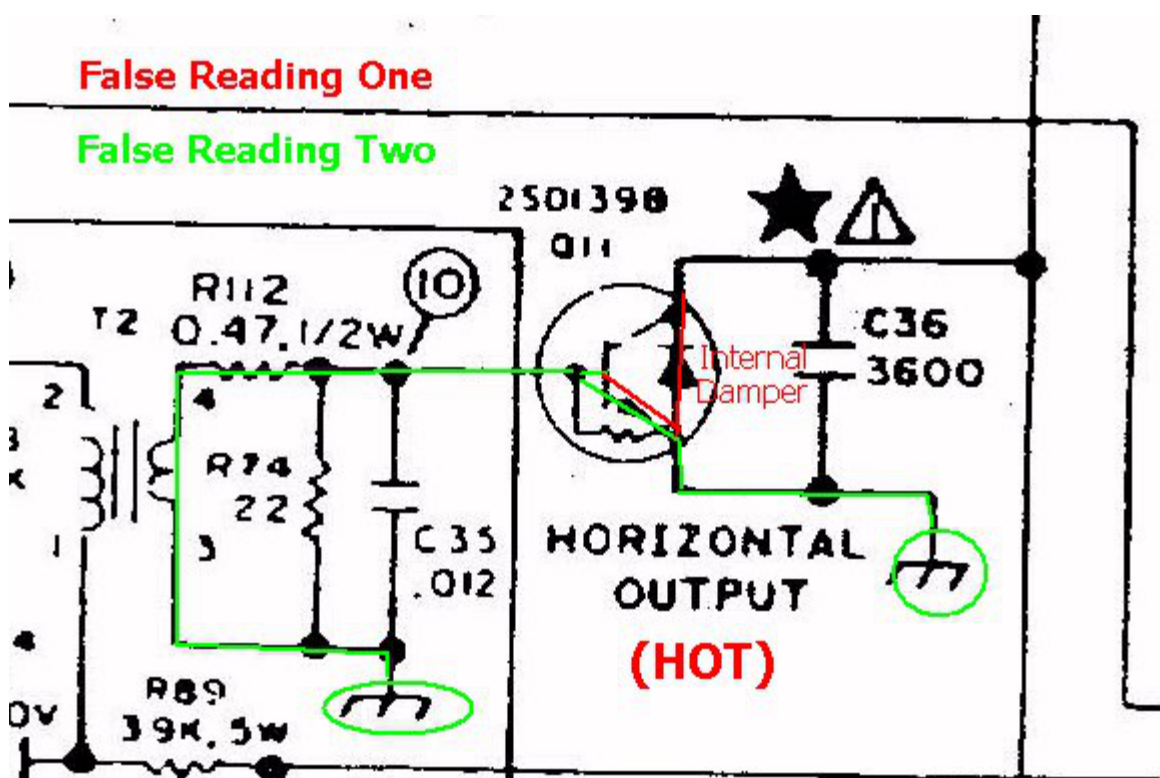
Regulator - 223-18-01- STR30123 - [1776]

FAQ - Do you have a replacement flyback for a WG K4600, K4700, K4800, K4900, K5500 or K5600?

No. This series of flybacks was so strong that no replacements were warranted. Only in recent years have they started giving up the ghost & at this juncture I would guess a person would go broke in repro'g them for the few that have died.

Frequently Heard - My HOT is shorted out according to my DMM.

You cannot measure a HOT in or out of circuit with a DMM if it has an internal damper. Many without a damper cannot be measured without removing at least one leg from the circuit. That's why no one has ever been able to pry my analog meter from my hands. I hate having to unsolder a component just to test it only to solder it back again after it proves to be okay. The reason for this when there is no internal damper present is from an external component bridging two of the legs... commonly a coil or flyback winding.



Many HOTs have an internal resistor, such as the one above, making it even a little more complicated when it comes to measuring it.

While here in the HOT seat another thing that seems to be a reoccurring theme is not putting the mica insulator back when replacing the HOT. The HOT has to be insulated from the framework or heatsink. When you remove the old HOT the insulator may be still

stuck to it. Usually it has enough heat sink compound still on it to reuse it with the new HOT, but you can always put a new one with new heat sink compound on the replacement for a fresh start. Some of the newer chassis' use a completely encapsulated in plastic case preventing the collector from shorting to the framework, but if you have one that the metal tab is exposed on you'll need to use a plastic screw, or at least a plastic insert with a metal screw, to prevent shorting.

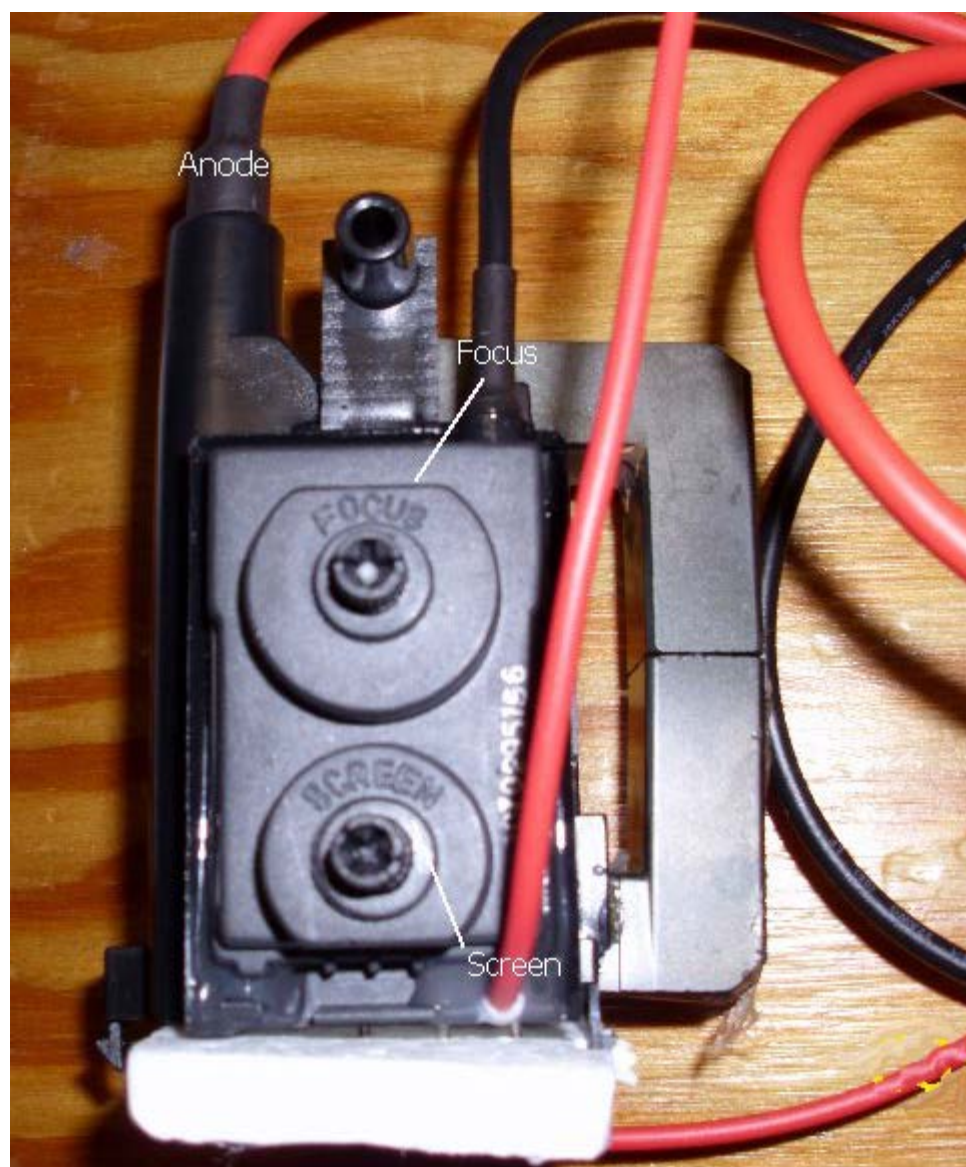
One other thing comes to mind.... over the past couple years I've had a dozen, or so, of the guys tell me that they've had trouble with heatsink compound that they've purchased from local stores being conductive. In each case the compound had to be removed & HOT replaced. The mount had to be cleaned with alcohol & allowed to thoroughly dry before replacing the mica & "good" compound for the new HOT. At least two reported seeing blue sparks dancing on the compound to the frame like leaky spark plug wires in an automobile. My guess is that this is probably something sold by a large nationwide electronics store to effect such a diverse number of states.

Update:

[Here's the source!](#)

FAQ - Which wire goes where on the replacement flyback transformer?

It doesn't matter what color the wires are. The 40KV heaviest wire with the suction cup connector on it goes to the anode on the CRT. The 20KV wire, next heaviest, goes to the focus pin of the neck board socket that plugs up to the CRT pins. That only leaves the lightest wire... usually 2KV... and it goes to the screen voltage post on the neck board. Actually, on most flybacks the screen voltage wire exits the casing right at the screen control, while the focus wire exits at the focus control.



- Microswitches -

What's the common for?

FAQ - Where do I hook-up the wire for the common terminals of my microswitches?

With an influx of newbies to the collecting world come some of the most basic questions that we all take for granted.

The answer should be self-evident on my Help Page [here](#):

Basically, you run a ground line from your edge connector ground & loop all the commons into it & then back to your starting point, attaching it to an adjacent ground position in the edge connector, so that if one connection to ground fails the other will keep the integrity of the ground circuit. You can also terminate your loop for each line that you run since it would be obvious as to the location of an open ground line by the area in which your switches do not function. For example, I always run a separate ground line for each of the following areas...
in the video bundle, the coin door bundle, player 1 bundle, player 2 bundle and for the speaker...so any switches used for player 1 controls are in a loop of their own from the first switch to the last switch & back to the start point on the first switch. If any one ground loop breaks it will still make contact in the opposite direction & if all switches fail in that loop I know it is between my first switch & the edge connector... the only lone common ground wire & easily identified by the junction of 3 black ground wires - in from PCB, start of ground loop & the closing ground loop wire. A *lasso* arrangement, so to speak.

The other question that usually accompanies this one is, "What size wire should I use to hook them up?"

Wiring other than the 18ga power conductors should be done with 20ga whenever possible & 22ga when you just don't have the 20ga that you need. Anything smaller than that is just a pain to work with & maintain. It might be fine for your thermostat wire in the attic of your home, or in the phone lines in your wall or any other app where the wiring is not exposed to us humans & has screw terminals for termination of that smaller wire, but right out here in the real world where we have to come in contact with this wire & utilize it for crimping, soldering or even the el cheapo push-in connectors... it just doesn't wash :-(Cabs used to swap in & out multiple PCBs don't stand a chance with the smaller gauge wires considering the amount of times they must be handled. The only thing I could think of that could be worse, would be using solid wire in place of stranded wire in game use :-(Now that's not asking for trouble, it's begging for trouble :-()

Replacement Jamma harnesses in their infancy tried to skimp on wire gauges & brought barrels of grief to buyers & techs alike. Wires pulling right out of the connector housing.... overheating power terminals... burning edge pads... having to crank the switcher open to full bore in order to bus the 5 volts to the components on the PCB... intermittent connections..... open connections where the insulation actually fooled you into believing that the wire was still connected by hanging onto the terminal saddle... and a parcel of other misadventures along the way to destinations via intra-cabinet break connectors.... CP, coin door, video & etc. To add ease to the demise of a connection, quite often the paws of even this *Big Bear* would sometimes snag a wire and yank it from it's home while removing or installing some component :-(

- Trackball Trouble -

Symptom:

No movement up or down!

Power off... remove optic connector with blue & violet wires for clock and direction and let it hang free. Now take the optic connector with green & yellow wires & move it to the now empty optic bd connector. Power on ... move trackball for left & right movement.

Results:

A. You can move up & down now by rolling the ball side to side.

Examine the first optic bd for a cold or open solder joint & replace if it appears to be okay as you most likely have a bad optic sensor.

B. You still cannot move in any direction.

You need to examine the connectors & wiring all the way back to the main PCB edge connector. If you find no breaks/opens in the wiring then chances are that you have a problem on board.

Symptom:

No movement left or right!

Power off... remove optic connector with green & yellow wires for clock and direction and let it hang free. Now take the optic connector with blue & violet wires & move it to the now empty optic bd connector. Power on ... move trackball for up & down movement.

Results:

A. You can move side to side now by rolling the ball up & down.

Examine the first optic bd for a cold or open solder joint & replace if it appears to be okay as you most likely have a bad optic sensor.

B. You still cannot move in any direction.

You need to examine the connectors & wiring all the way back to the main PCB edge connector. If you find no breaks/opens in the wiring then chances are that you have a problem on board.

Happy Gaming.....

- Illuminating A 2¼" Trackball -

This one has been topping the charts for quite sometime, so it's earned a spot up here.

- How do I light up my mini trackball unit?

Well... this is how I do it... right or wrong! First you disassemble the unit & since you only want to be toting the case bottom around for modification, I'd suggest you leave the harness on the optic bds with the case top in the positions they go in. This should be of help when you go to put it back together, physically noting where they belong, preventing you from mixing up vertical & horizontal wiring.

Next would be to wash up the bottom case with dish soap & warm water, rinse & dry, & you're ready to drill. The center hole needs to be enlarged to 3/8" to allow enough light through. I use a step drill for this, but I imagine you could use a std 3/8" bit utilizing the existing hole as a pilot. Now take your lamp/lamp holder & align it over the hole. If you align the filament inside the bulb with the center of the hole it'll give you a more uniform look. Keeping this alignment you can pivot the holder to a good location for fastening. If you are going to drill a pilot hole make sure that it will not interfere with any necessary components on the inside, e.g., don't drill the hole where the screw will go right up through under a bearing :- (I always chose not to drill the pilot, but to use one of the slots to either side of the case for fastening. The screw makes it's own threads as it goes. I've never cracked a case... hmmm, sounds like something that Perry Mason would never say :-)... in doing it this way, but I have wondered if things were going to go smoothly many times. I was afraid it would crack the first time I tried this on an old broken case, but that was not the case, proving once again that you just never know till you try something new.



K.... reassemble the TB unit & mount it back just the way you found it!!

Note: DO NOT overtighten the screws that hold the case together! They only need to be snugged up hand tight & trying to reef them will destroy them now, or later.

Now we need some power to illuminate this lamp. If you take a couple pieces of 20ga wire, 1 black for ground & 1 orange for 10-12VDC, about 10" long, you can fasten them in no particular polarity, across the 2 terminals of the lamp holder. Add a Molex 2 position connector to the other end & then cable tie it to the TB harness. This keeps it contained with less risk of it getting entangled in the moving parts of the TB. Note: If you decide to use a 6 volt lamp you can swap in a red 20ga wire for the orange above. Keeping power lines color coded is not only neat & useful, but it might save you, or some tech in the future, a whole lot of guess work.

Now you'll have to continue your wiring from the other side of your newly installed connector to whatever power source you have selected. I recommend that the 5VDC logic lines not be tapped into. Why add the extra load when you have such a vast selection of sources at hand. To keep lines to a minimum in most cabs you have your control panel & coin door break connectors in the same general area, if not side by side, making it easy to tap into coin door power lines. Obviously, your black ground wire can tap in anyplace that has a logic ground line passing by. As for the orange wire, most coin doors have a drop for 10 to 12VDC to provide power for coin lockouts, if used. Sometimes the coin meters are driven by 12VDC, also.

Oh... for the red wire people that are thinking if they can't use the 5VDC logic power, where do they derive their power from... many coin doors have 6.3VAC power available for coin rejector illumination, whether or not it is used, it can usually be found in the coin door break plug... cab side only if not already in use. Always consult your game's manual to see what power is available to you in your particular cab.

Of course, if this is going into a cab of your own design, you can provide the power directly from your power supply up to the area of your control panel. You'll still need to use a break connector just prior to the TB.

- In this wedge lamp holder use a #555 lamp with 5 to 7 volt source, or a #161 lamp with a 10 to 12 volt source. Make sure you use a translucent ball lest this be all for naught;-)

Ready to smoke test it.... good luck & Happy Gaming....

PostScript: I mentioned that I used a broken case to experiment with years ago, and I should mention how many of these cases were prematurely sent to the junk pile :-(It seems ops.... and now hobbyist... frequently wanted to use a no-no shortcut to testing their optic bds in these units by prying them up at the case "T" that holds them in place, enough to slip the bds out :-(Don't be caught caseless because of this needless shortcut... spend some quality time with your TB & it will be around for many years to come :-)

- Great 1000miles Rally Notes -

This pcb uses the basic Jamma connections plus a few extra connectors. There are 2 connectors on the lower board...a 6-pin and a 5-pin. The 6-pin is for connecting a 360° steering wheel. The pinout is as follows:

- 1 nc
- 2 nc
- 3 + 5volts
- 4 clock
- 5 up/down
- 6 ground

In order to use a 360° steering wheel you must put dip switch 1 on at the 4 position dip switch located next to the header connector & dip switch 4 on / 5 off at the 8 position dip switch located at the pcb right side.

The pinout for the 5-pin to connect up a 270° steering wheel is as follows:

- 1 + 5volts
- 2 potentiometer

- 3 ground
- 4 nc
- 5 nc

In order to use a 270° steering wheel you must put dip switch 2 on at the 4 position dip switch located next to the header connector & dip switches 4 & 5 on at the 8 position dip switch located at the pcb right side.

When using the 270° steering wheel you must center it. To do this, align the wheel to straight ahead position & hold the start button down while powering up the game, and wait for screen to say "wheel adjusted".

8 position dip switch functions:

- 1 normal mode / test mode
- 2 screen flip
- 3 cab type UR / CT
- 4 joystick control off / steering wheel control on
- 5 360° wheel off / 270° wheel on
- 6 on no brake button used / off brake button used
- 7 used in conjunction with 8
- 8 both off=flags & national anthems / both on=none / 7 on=anthems / 8 on= flags

Test mode....dip 1 on....choices are "input device check", "system setting" & "sound test". Use start button to select your entry & use accelerator button to change.

Input device check is the standard I/O check for testing buttons & wheel.

Systems setting is for adjustment to coin/credit, difficulty, language, flags, anthems, & clearing game records. Any changes made must be saved before leaving via selecting "memory the setting & exit".

Sound test is obvious with the exception of sound on demo mode. To toggle the sound in demo mode on & off you need to press the start button & the accelerator button at the same time.

- Atari's Big Blue -

Big Blue is the huge 2" in diameter blue capacitor mounted in the transformer assembly in the bottom of Atari cabinets. Since most are about 20 years old at this point in time, they have a much higher failure rate now... not that they haven't failed prior to this date... and they create a wide range of problems & should be changed. Symptoms range from not powering up at all to randomly powering up. Many problems blamed on the monitor are actually a result of this cap being weak or bad.

Here are 5 Big Blue Symptoms that are erroneously blamed on the monitor.

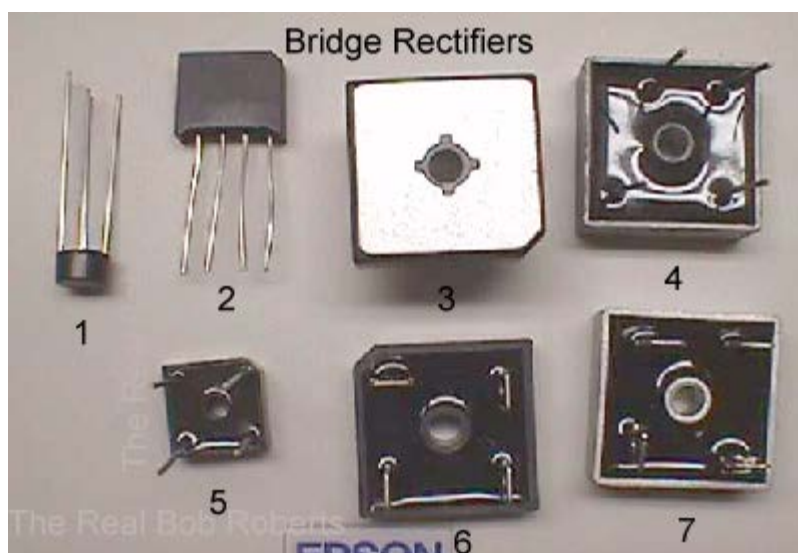
- 1 Intermittent lightning streaks in pic/hum bars/weaving.
- 2 Blank raster... steady or intermittent.
- 3 Jumpy pic sometimes described as jiggles.
- 4 Failure of H hold to lock in.
- 5 Intermittent vertical roll or failure to lock in.

- Bridge Rectifiers -

Here's a question that I'm asked a minimum of once a week, & most times more than that, so I guess it is time to throw up a quick response here. The basic question seems to be 'how do I know what's what on this bridge rectifier?' and the

answer is easy, although there are some variances and some multiple ways to tell. Basically all you need to know is which terminal is the + terminal & the others fall into place for you. The - will be opposite the + & the 2 remaining terminals will be the AC in feed from the transformer in an 'it don't matter' arrangement :) How does the mfr let you know which terminal is + ? It's done several ways... sometimes a couple different ways on the same bridge... with one way being the + lead is left longer than the rest on a wire leg bridge... the pattern of the terminals will be such that 3 are alike with the remaining one being different in it's position or appearance... and finally, by earmarking the case at the + terminal. Well, of course, there is one other way... labeled! This way would have the + & - opposing each other & the opposing AC terminals marked with this symbol ~ .

Anyway, the point is that you can often identify a bridge's pinout with it laying upside down in a parts bin if you know what to look for. K... it's time for the pic that replaces the thousand words now, and I'll go over this handful of bridges pointing out what to look for.



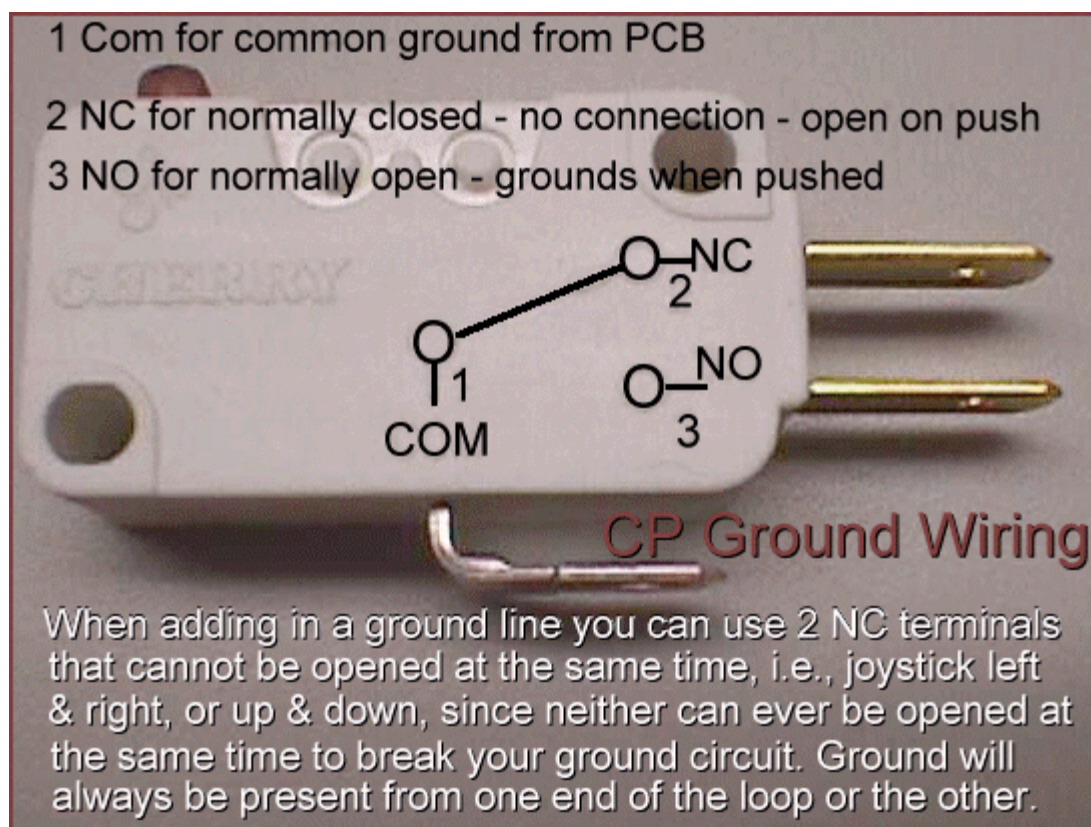
- 1 is a round bridge & it is most commonly marked with the long lead for + making it easy to go in either direction to end up with the - separated by an AC terminal, i.e., positive - AC - negative - AC. Another way of marking this is the case which will have a flat spot right at the + terminal.
- 2 is an inline bridge & is marked by the long lead and/or dog-eared case as in the pic [top right corner of the case]. With the inline type the opposite would be at the opposing end, i.e., the 2 outside terminals are + & - with the 2 inside terminals being the 'non-polarized' AC terminals.
- 3 is a typical 35 amp bridge with .25 quick connect terminals & looking at it from the top as in the pic, it's easy to see that the top left-hand corner is - with the top right being AC, lower left AC & the one that gave the whole thing away, bottom right dog-eared + .
- 4 is a 35 amp wire legged bridge with the one leg in the upper left-hand corner located in a different position compared to the remaining 3 legs, so the odd one out is the positive making the lower right the negative, leaving only 2 terminals for the AC connections.
- 5 is a smaller 6 amp bridge that is marked 2 ways... longer lead at the + terminal & a case that is dog-eared at the top right in the pic.
- 6 is the bottom side of a 35 amp quick connect terminal bridge and it is easy to spot the dog-eared case once again, as well as, the odd one out terminal beside it.
- 7 is the neighbor of 6, but it does not have the dog-eared case, only the odd placed terminal at the lower left marking the positive end.

I guess the easiest way for a newbie to grasp the polarization is to think of this bridge as though it were a battery. You know that when you put an ordinary "D" cell in a flashlight that the + end has to go toward the lamp and that the - or negative end is the ground for the lamp. Well... this is basically the same, so your cab wires coming from the negative terminal of the bridge are the grounds, while the wires that are going to the + terminal of a big filter cap are the positive DC wires. That should answer the Q of what color wires are on the bridge in my game? It really doesn't matter so long as you know that the 2 AC terminals have the wires attached that go to the transformer, and the - terminal is going to

ground while the + terminal is the one that supplies the DC voltage & needs to be filtered through a big cap.

Oh.... I don't get a reading across the 2 terminals...do I need a new bridge? Almost forgot that Q ;) Remember to measure across the 2 opposite terminals marked, or determined to be, AC with your meter set to measure AC and do not try to measure it to ground. Then set your meter to DC voltage to measure the DC from the + terminal to ground... sometimes better to locate a remote ground. This will verify that your ground system is intact, providing you get your expected DC voltage reading.

- Cherry Switch -



- A Couple G07 Notes -

The first thing is the mod to the G07 chassis that upgrades the sync circuit to handle the newer PCBs eliminating top curl in the pic. The way the instructions were written seem to be hard for some to follow, so I'm going to put my own notes on it as posted in RGVAC in 1998 here & hopefully they will be easier to follow. To make the upgrade do this:

- -First.. remove C501 & chuck it out.
- -Second.. remove C303 & place it in the holes for C501 & solder.
- -Third.. clean the solder from the hole between the 2 holes where C303 was removed & fill in the one furthest from the chassis edge with solder.
- -Fourth.. put a 10 to 22uf @ 25 volt minimum in the now closer together holes at C303 with the longer positive lead going thru the hole closest to the edge of the chassis PCB & solder.
- -Fifth.. after reinstallation of the chassis adjust the H hold for a center point without the curl.

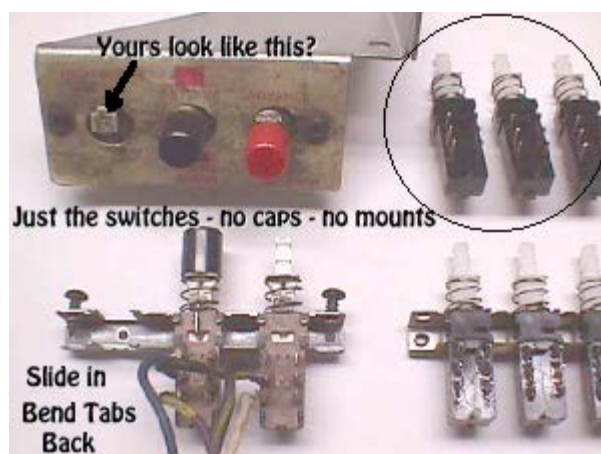
Next is the original G07 chassis [G07-CAO](#) and the installation of a cap kit. This uses the same cap kit as the [G07-CBO](#) with the following changes:

1. C517, which is a 470uf 16v cap will be replaced with the caps from the kit marked for C517 (100uf 25v) & C518 (220uf 25v) at the now unpopulated site of C518. This is a parallel network which adds to total 330uf 25v across the side pin xformer T503 and since it is parallel, it makes no difference if you mix up the two positions so long as you install them with the correct polarity. Hint: Both ground sides will be closest to the flyback xformer. Note: Electrohome warned about replacing these 2 caps with a single larger value cap in any of their chassis'. This 2 cap bridge should always be used on any G07 version.
- 2. C302 (220uf 25v) is not used.
- 3. C407 (4.7uf 63v) is not used.
- 4. The extra cap used for upgrading the CBO version's sync will not be used.... C303 (10uf 50v).
- 5. C301 (3.3uf 50v BP) is not used since we include them in our kits.
- 6. C520 original BP cap is upgraded to 3.3uf 50v BP.
- 7. C511 (47uf 160v) if it still has an axial cap you'll need to install a radial.

So you should have 4 spare capacitors from the kit to have on hand for the next project that is almost certain to need one of them... well, positively if you did not have them on hand... isn't that always the way it happens :-)

Thanks to Bryan Kruzynski for supplying a lot of info to work with here.

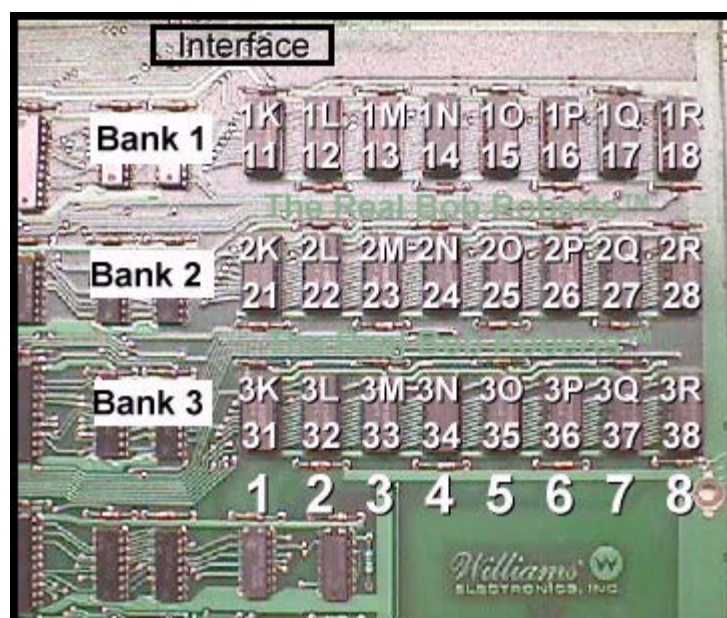
- Broken WMs Service Switches-



If you've got broken service switches... sheared off, sticking, poor contacts or whatever... on your Defender, or other Williams games, you can replace the switches individually to restore them. All you need to do is gently pry the four tines that hold them in place up to a horizontal position & slide the broken switch out & insert a new one. Bend the holding tines back enough to keep it steadfastly in place & transfer your wires to the same positions on the new switch as they were on the old & you're back in business again.

I have replacement switches on the Parts Page at \$2 each, but you'll have to use your old red or black button caps & these new switches do NOT replace the later WMs type that used white switches with poles on one side only.

- Williams Ram Layout Chart -



- Free Play -

Of all the ways I know of to make a game operate on free play, including cpu controlled, I think the best one is by using the 2 player start button which will work on a good 95% of games. Open your coin door & ID one of your coin switch wires that goes back to the pcb... not the ground wire that is looped to all switches... and then locate the wire leaving the player 2 switch & going back to the pcb. All you need to do is join these 2 wires together in some fashion. You can use [splice connectors](#) and a piece of 20ga wire to connect the two together. Getting fancy with this version, you could add an on/off switch on the inside of your coin door in-line with this circuit enabling you to flip the free play on & off when coin play was desired. You could go to the edge connector end of the harness to simply splice both lines together as they leave the pcb eliminating the need for a piece of wire. For all you shade tree techs... yes you can do it on-board, but you know I hate hacking up classics :-)

Once this is done, pushing the 2 player button will put up 1 credit to play a single game and pushing it a second time will start a 2 player game if desired. The reason that I prefer this method over the others, including dip switch free play, is that the games attract mode is left intact adding many years of life to the CRT's phosphor, i.e., less burn in on the screen.

- Diode! Which Way Did It Go! -

I "hear" this a lot & it's usually accompanied by ... I just want to know which way is the correct way to put it in & don't care what it does, be it blocking, single, half or full wave rectification, or if it's just in there to add to the weight of my game! Here's a couple examples, maybe oversimplified, that should help you determine the correct way on your own. First I'll paste an excerpt from the WMs Battery Conversion Page that might prove to be of some help:

This will work in many other cases, but beware that you cannot just drop this in place of a ni-cad without defeating the charging system. This can be done by installing a blocking diode in the + line. I'm quite frequently asked how one can tell which way to install the diode. I think it is easiest for a newbie to think of the cathode stripe on the diode as a gate in the front yard fence that only opens outward as you are leaving your home, with the body being your walkway, of course. No one can walk up to your gate & pass through to enter your home, but you can walk down your walkway (diode body) and out through the gate. A diode with the complete symbol imprinted on it will have an arrow with it's point butted up to the cathode band signifying the direction of flow. If used as a blocking diode for a lithium battery you would want the cathode on the end furthest away from the + terminal, thus allowing the flow down the walkway to the

components, but blocking at the gate any flow back towards the battery.

A common app that may even need 2 diodes would be coin meters, if used.



Your meter may have a diode installed inside to prevent spikes, called a clamping diode, and if it does, you'll find a + & - sign on the side where the wires come out as pic'd below.

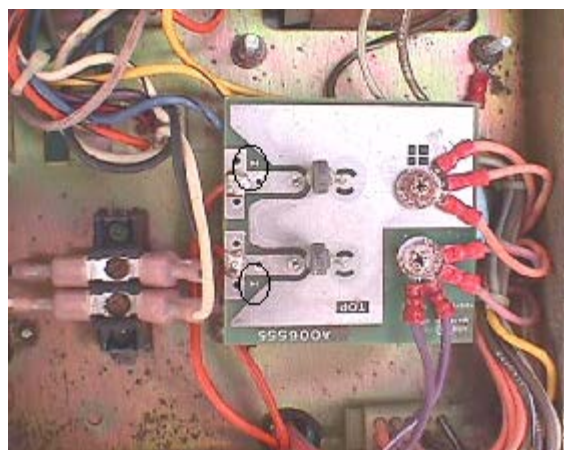


Most meters with internal diodes will have color coded leads to aid in identifying polarity with red for the + side & black for -. The + side will connect to your voltage source, which should match the voltage rating found on the meter, as well. The - side will connect to your pcb's circuitry for pulsing the meter low (ground).

If your meter does not have the internal diode you can put your own across the 2 leads. Since you have no polarity at this time, it makes no difference which way you install it, but once installed, the cathode (banded end) becomes the + side & must connect to the power source. The other side will go to your drive circuitry of your pcb or whatever else you may be using.

If you want to install a coin meter & your PCB doesn't have any drive circuitry, you can connect it directly to the coin input circuitry. As your coin switch closes to pulse the input for your PCB, it also pulses the meter. This will work well with a 5 or 6 volt meter, but if you are using a 12 volt meter you do not want this 12 volts feeding back into your circuitry on your pcb & damaging it, so you can use another diode to prevent (block) this from happening. If you install a diode in the coin switch line coming from the PCB in the direction of the arrow with the banded side (cathode) towards the meter & coin switch it will block the 12 volts from feeding back into the board circuitry. Sound familiar.... it's the same blocking action used on the Tron/MCR battery conversion to stop the on-board charging system from feeding into the lithium battery.

Here's a recently asked Q that will fit right in here, about replacing the diodes on an Atari xformer assembly for an Asteroids.



From the pic you can see that the older ones were not plainly marked with a band for the cathode side. They have a very thin pic of the symbol depicting the direction of flow on the side, but it is quite often worn away over time. In almost every instance you will find the symbols stamped on your PCB. In the case of this small PCB that mounts to the "Big Blue" capacitor, the symbols are very small themselves, so I circled them above. If you look closely you'll see the entry arrow butting up to the cathode band which faces the capacitor. This board with the 2 rectifiers forms a conventional full wave rectifier. Later Atari assemblies came with a full wave bridge rectifier. You might also note the + symbol on the pcb signifying the positive side for the Big Blue capacitor.

- Lamp Socket Tip -

Coin door lamps & lamp sockets have been the source of many Qs over the past 8 years, and although I have addressed quite a few of them on my Help Page, this particular tip has not been covered & I think it's about time it was, so I'm jumping it to the top of the to-do-list.

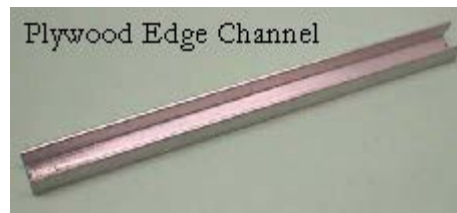


These are two of the common types of lamp sockets used on the coin doors. The older type on the left was a constant source of problems after many years in the field because of the sockets loosening up enough for the terminals to spin. They were slightly better than the ones used on the old WMs coin doors, but nevertheless, a problem. Ops used to bend them all out of shape when replacing the lamps & I'm sure that didn't help in any way.

Then later on when they saw that the newer type, as pic'd on the right, was holding up much better, they would remove the old sockets & bend the tab straight back to slide on one of the newer sockets, as pic'd below.



The trouble with this was that the bending of the tab weakened it so much that they often times broke clean off :-(I located some small "L" brackets meant for shelving at a local lumber store (pre-Home D) that worked out perfect when fastened in place of the old bayonet socket. You could just slip the newer wedge socket right onto it aligning perfectly. As is the case with so many good things, they simply disappeared from the store's inventory and said to be no longer available. The store chain is no longer now :-(



|ramble| Sometime back in the day, I had read an article in one of the industry mags about using aluminum plywood channel over the piston rod of the pneumatic jukebox door lifters to prevent them from closing while your head was still inside them :-(Since my trusty short cue stick had once failed me, causing me to see many new stars that I hadn't seen before, I was keenly interested in this channel & ran out & purchased some to give it a try. I cut off a piece for a Rowe jukebox, opened the box, inserted the channel and it worked like a champ! I ended up stocking every size I could find & had cut pieces to the correct length for various brands & styles of jukes, labeling them as I went. I found many uses for this channel around the shop & in makeshifting parts that were hard to come by. This channel worked out well for this lamp socket mount, as well. |/ramble|



I never used a pattern for this, just cut them out as I needed them, but I'll put the basics here. First, I would drill a hole in the channel front about $\frac{3}{16}$ " from the end, centered, with a small step drill. I believe the first step is $\frac{1}{8}$ " if you're using a std drill bit. After the hole is drilled & any burrs polished away I would just slip the piece into the vise & cut off a piece of channel approximately $\frac{7}{16}$ " to $\frac{3}{8}$ "... always did it by eye & never had a problem, but you may want to get an exact measurement if you plan to try this.



I never bothered to cut off the upper unused portion, but I suppose you could take it a step further & remove it if you wanted to. If you don't have the original screw it can be fastened with a 1/4"x440 bolt & nut as pic'd above. The channel comes in various sizes to slip over the cut edges of plywood shelves... 1/4"... 3/8"... 1/2"... 3/4"... and the size used for this app is the 3/8". The channel can be found at Home Depot with some searching... seems no one that works there ever knows where, or what, this stuff is & it appears to be in a different location in every store :-(

I see that lots of you have trouble with the types of lamps & sockets, along with the voltage that is used to power them, so I'll insert a brief comment here on this subject. First the bayonet type is a lamp with a smooth cylinder base that has two projecting pins which fit into slots on the holder & when twisted a quarter turn, lock themselves into the socket. Bayonet lamps would be #44 or #47 when used in a 5 to 6VDC or 6.3VAC circuit, and when powered by 12 volts you'd need a lamp such as the #1813. The wedge type is as implied, a wedge lamp is pushed straight into the socket & has a chisel-shaped base, as opposed to, the cylindrical bayonet type. One loop of exposed wire to either side of the wedge base makes contact in the socket. Wedge lamps used in a 5 to 6VDC or 6.3VAC circuit would be #555 & in a 12 volt circuit you'd need #161 lamps.

As for voltage needed in your particular cab, even if there are no lamps in it & you have no manual or schematics, you can always measure the voltage right across the two wires that feed the lamp... right at the socket. If you own a game you should have a meter, but on the off chance that you don't, any meter should do the trick, even a small pocket-sized \$5 analog meter from your local electronics store.

More to Follow

Happy Gaming... **The Real Bob Roberts™** Happy Gaming...

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Using a G05-801 Monitor In A G05-802/5 Wired Cabinet

by Bob Roberts

I'm going to post the pinout for the adaptor to use a G05-801 monitor in a game cabinet wired to use these monitors... G05-802, G05-805 or V2000. This should be a good aid to anyone who is into building their own adaptors. For those of you who would rather buy it assembled it is on the Parts Page here...

[G05-801 Monitor Adaptor](#)

12 Pos Amp .084 Cap/Pins

- Pin 1 Green 20ga
- Pin 2 Yellow 20ga
- Pin 3 Red 20ga
- Pin 4 **Black** 18ga (Pin 11)
- Pin 5 White 20ga
- Pin 6 Gray 20ga
- Pin 7 **Red** 18ga
- Pin 8 Brown 20ga
- Pin 9 **Orange** 18ga
- Pin 10 **Red** 18ga
- Pin 11 **Black** 18ga (Pin 4 Loop)
- Pin 12 **Orange** 18ga

6 Pos Molex .093 Recpt/Socs

- *****
- *****
- *****
- Pin 2 & 5 Loop **Black** 18ga
- *****
- *****
- Pin 1 **Red** 18ga
- *****
- Pin 6 **Orange** 18ga
- Pin 4 **Red** 18ga
- Pin 3 **Orange** 18ga

7 Pos Molex .156 IL

- Pin 5 Green 20ga
- Pin 3 Yellow 20ga
- Pin 1 Red 20ga
- Pin 4 White 20ga
- Pin 2 Gray 20ga
- Pin 7 Brown 20ga
- Pin 6 Key



The Real Bob Roberts Color Assignment

Using a G05-802/5 Monitor In A G05-801 Wired Cabinet

by Bob Roberts

I'm going to post the pinout for the adaptor to use a G05-802, G05-805 or V2000 monitor in a game cabinet wired to use a G05-801. This should be a good aid to anyone who is into building their own adaptors. For those of you who would rather buy it assembled it is on the Parts Page here...

[G05-802 Monitor Adaptor](#)

12 Pos Amp .084 Plug/Socs

- Pin 1 Green 20ga
- Pin 2 Yellow 20ga
- Pin 3 Red 20ga
- Pin 4 **Black** 18ga (Pin 11)
- Pin 5 White 20ga
- Pin 6 Gray 20ga
- Pin 7 **Red** 18ga
- Pin 8 Brown 20ga
- Pin 9 **Orange** 18ga
- Pin 10 **Red** 18ga
- Pin 11 **Black** 18ga (Pin 4 Loop)
- Pin 12 **Orange** 18ga

6 Pos Molex .093 Plug/Pins

- *****
- *****
- *****
- Pin 2 & 5 Loop **Black** 18ga
- *****
- *****
- Pin 1 **Red** 18ga
- *****
- Pin 6 **Orange** 18ga
- Pin 4 **Red** 18ga
- Pin 3 **Orange** 18ga

7 Pos Molex .156 Header

- Pin 5 Green 20ga
- Pin 3 Yellow 20ga
- Pin 1 Red 20ga
- Pin 4 White 20ga
- Pin 2 Gray 20ga
- Pin 7 Brown 20ga



The Real Bob Roberts Color Assignment

G07 Chassis Repair

What Can Go Wrong??

--

By Bob Roberts

There must be more Electrohome G07 chassis' left out there than any other model ever made. I know that they are the subject of many questions day in & day out and that more G07 cap kits are sold than all the rest combined. For this reason, I chose the G07 to explore the reasons why newbies so often have trouble with seemingly simple cap kit installations. I hear/read it every day & it is always something like these:

- I just recapped a G07 that was working, but had issues that needed to be cleaned up, and when I finished with it I could not get it to work at all!
- After installing a cap kit in my G07 it smoked on power up, so I unplugged it immediately. What should I do now?
- Did a cap kit job on my G07 monitor & now it blows the fuse every time I power it up. Help!!
- Just installed my first cap kit & when I powered up... ka-pow!! One of the caps must have been defective because it blew up!!!
- I did a stupid thing :-(I plugged the chassis in without using an isolation transformer & now it won't do a thing! What did I screw up?

I should have had the answers ready for a cut n paste, but I always took the time to punch out the answers on the keyboard, as needed. Maybe I can just point to this page in the future... if I do it right :-). Most of the things are just common sense things, but quite often, and especially when something blows up on you, there is a tendency to PANIC! I'll put a list of what I would say should be the chronological steps to take at the bottom of this page, but I think showing you via pics on a chassis that I repaired for a newbie when all else failed... and you'll soon see why... would be beneficial since it has many of the common mistakes & problems that arise.

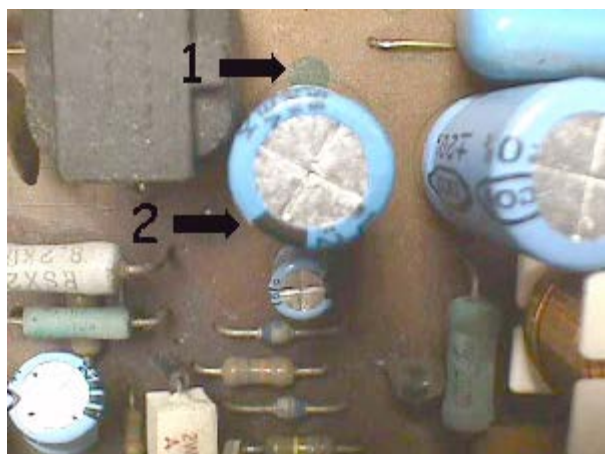
K... below is a pic of the first thing I noticed about John Doe's chassis... got to protect the innocent, you know :-)



K... of course, he could have just blown the fuse for a second time & didn't have a replacement to put in there before sending it to me, but I have seen many come into the shop for repair where the fuse was just forgotten after installing all the caps. Let me add my standard caution here in regards to this fuse being blown.

Caution: When removing your G07 chassis from the monitor frame... after discharging the CRT... always take care not to touch the solder side of the chassis until you have a chance to discharge C904... the large gray electrolytic cap to the left of the fuse area above. This capacitor bleeds its charge to circuitry beyond the fuse F901, so when F901 is open the capacitor stays fully armed with a charge that will bite you when you least expect it :-(If you've powered the chassis previous to removing it then the cap has a nice fresh charge on it just waiting for you to provide a path to ground... not that old charges have less bite, but someone may have discharged it previously if it had just been laying around & had

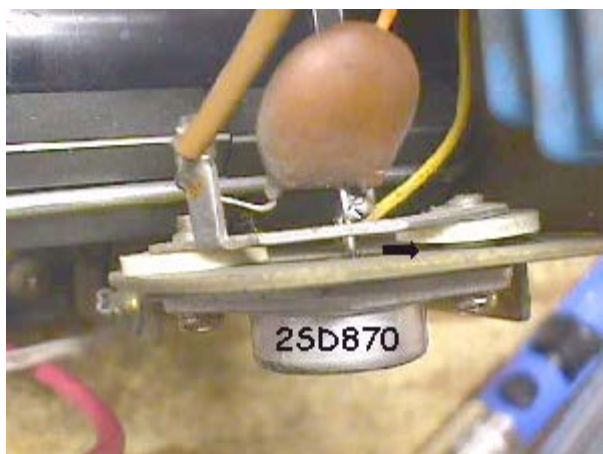
not been plugged in. Some caps hold their charge for years, while others dissipate in a matter of weeks, so you just never know what is in store for you, so always discharge this cap. There is quite a snap to this, so you may want to use a resistor to shunt this charge to ground rather than just shorting it to ground. On the frame, this provides a quick way to see if you may need a flyback xformer. If you take a jumper wire & clip one side to ground... while the monitor is unplugged... & dangle the other end down to the fuse end furthest from the back of the chassis & it sparks, chances are good that you'll have to replace the flyback.



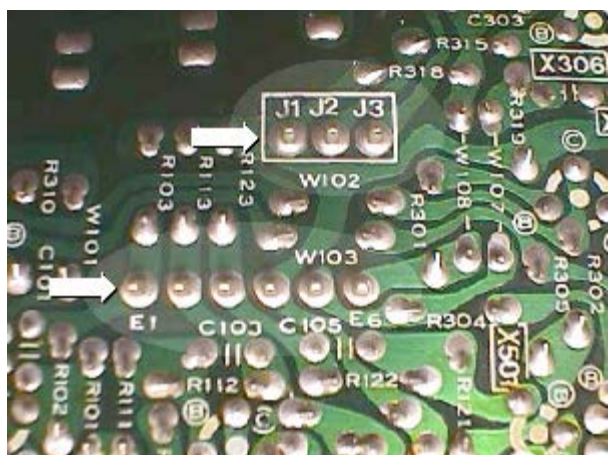
Now... this next pic is to highlight C511 in the center & arrow 1 is pointing to the dark circle on the chassis that indicates the ground side, and it is painfully clear that arrow 2 is pointing to the stripe on the cap that indicates the ground lead side which is 180° out of sync :-). With the chassis left powered for any length of time this cap will blow open at the relief scores in the top, spewing forth a shower of tin foil bits resembling confetti. Once a cap has been powered up in this manner it is always best to replace it even if it works when you swap it back to it's rightful position.



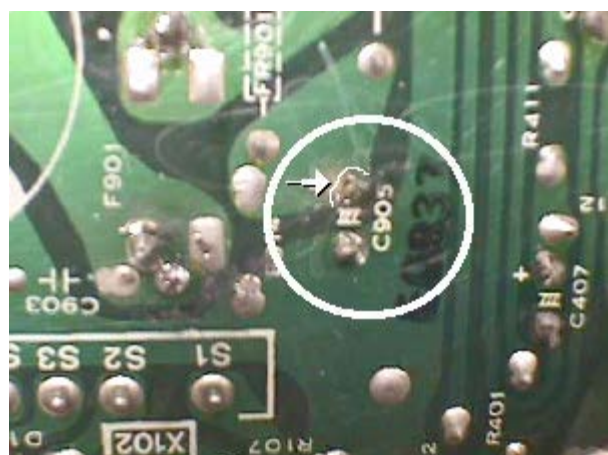
Here's a pic of something I hear people say is impossible to do all the time. I've heard this statement made by some of the best over the years ... "You cannot mount a TO3 transistor backwards!" Wrong... wrong... wrong! Where there's a will, there's a way! I've seen this countless times in the Wells-Gardner K6100 monitors of Tempest fame, as well as, many other brands & apps. I cleared everything away & mounted this TO3 backwards just so you could see what happens when they are mounted backwards. Both the emitter & the base pins are touching the frame & should be right out in the center of the holes when mounted properly.



The subject chassis is not as bad, but the HOT's collector is shorted to the frame due to poor mounting. The insulators that keep the mounting screws from shorting to the frame were not seated properly allowing the short to occur. The screws actually need to connect the transistor case... the collector... to the isolated retainer where it is then fed to the primary winding of the flyback xformer.

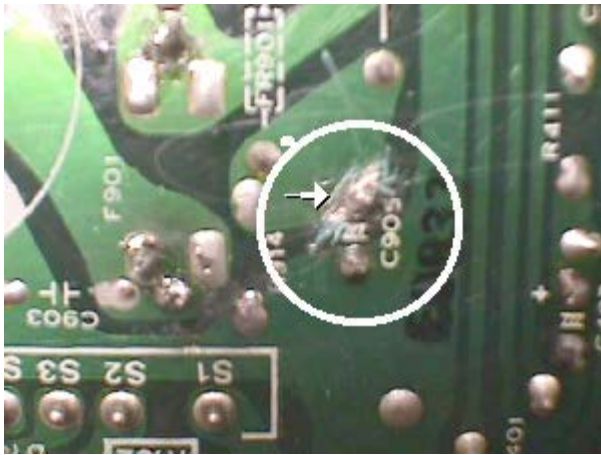


With the pic above I was trying to show solder ringlets on the video & sync headers, but they don't seem to show up well in pics. The 2 headers... 3 position negative sync (top arrow) and the 6 position video & positive sync (lower arrow)... were like baby teeth, loose to the point of almost being able to pluck the headers out with your fingers. Needless to say, this is not good for sync or video & sometimes manifests from one missing color, to several missing colors, to lack of vertical sync or horizontal sync, or any combination of the above. In fact, only one of the two grounds is usually connected, so if it's header pin is broken free from the solder pad you will have nothing on the screen to a negative pic that you cannot sync at all. These headers should be resoldered when you do your cap kit to ensure a good & lasting job. Start at one end of the header & reflow the old solder with new to soften it up & then remove it leaving a nice pretinned pad & pin to solder anew. Step through the rest of the header pins in the same manner, as this goes along rather quickly taking only an added minute to add to the longevity of your chassis.

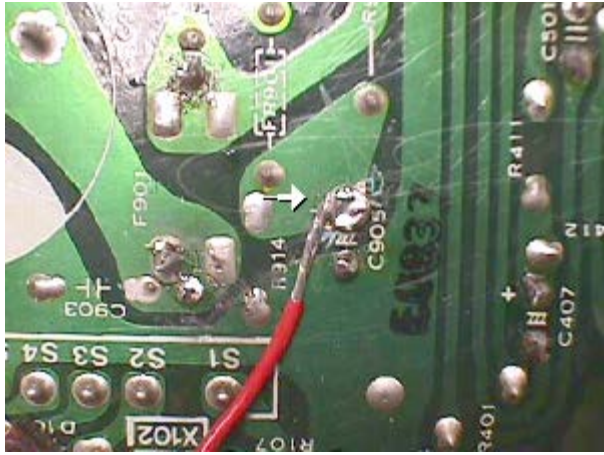


Here is another all too typical problem. C905 above is soldered in, but the pad is torn around the solder & not making connection with the overall pad, making this a small island with paths to nowhere. This is why it is necessary to measure with an ohmmeter from component leg to the next component leg in the

same trace to ensure continuity with the rest of the circuit.



This is how I always repair these... rejoining the island to the mainland. First, it's necessary to scrape the coating off the mainland around the joint to expose the copper trace. Next tin the area... JIC, tinning is nothing more than applying a minute layer of solder to the surface to aid in bonding the two pieces together. You could just go ahead & solder over this area to join them into one pad, but flexing of the board, aging & other contributing factors may create a cold solder joint & intermittent problem sometime in the future this way, & they are much harder to find, so we don't want that.



The way that I have found best for a long lasting job is to take a piece of wire, strip back about one inch, tin it, take a small pair of needlenose pliers & form a ring at the end of the wire. Then place this ring over the cap leg & joining the island with the mainland, solder it into place. Snip off the excess wire that you utilized as a handle to keep from burning yourself & you're finished with it :-)

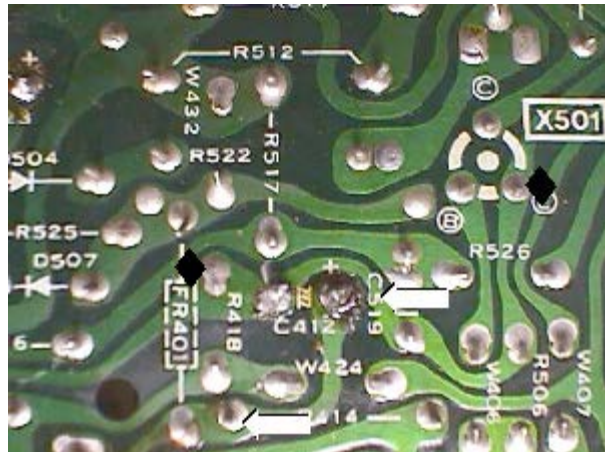


This poor chassis never stood a chance :- (In the pic above, the top arrow points to C523 which is shorted by small beads of solder in the flux between the terminals of the cap. The lower arrow is pointing to another no connection point on C511... and it is also pretty messy looking... but this is the cap that is in backward & needs to be removed, anyway. Pushing lightly on the top of the cap shows that the leg which appears to be soldered in, moves up & down with the glob of solder staying with the leg... pulling away from the pad :- (This reminds

me of another problem I've seen frequently. The replacement caps are soldered in with the body up off the chassis board, i.e., high water installed! I don't know where this comes from, but installed in this fashion leaves an opening for debris to get under the cap & short the legs together & it also provides an easy way to break the cap free of the pads below by any accidental bumping during handling or even later down the road when trying to adjust the monitor. When you have a real mess from soldering, such as above, you can clean up with household items. Just find an old toothbrush... for that matter, new ones can be bought at the Dollar Store (5/\$1), & a bottle of rubbing alcohol. Brush & blot the connections clean & you'll be able to readily spot any potential debris that might short connections.



Oh my... I remember very vividly the words, "I've checked my cap orientation over & over again! They are in there the right way!" Oh well... when I flipped this one back over I spotted another in backwards... C408. Here's a tip to spotting these easily when looking at a chassis that someone else has recapped. If you look at my [G07 Cap Map](#) you'll notice that a majority of the ground bullets are facing the front of the chassis or toward the flyback. In fact, there are only 4 that deviate from this pattern & 3 of those are under the metal shield out of sight. Knowing this when you look at the chassis makes C408 stand out as it's ground stripe is facing away from the flyback & general population of caps.



C412 above is also soldered in very poorly & the way that this was determined as a problem was with an ohmmeter as previously stated. Measuring from the positive terminal of the cap to the next component in line... R414... as shown by the white arrows, my meter did not want to zero without a bit of wiggling around of the probes. Cleaning & resoldering straightened this out. Looking at the ground side of the cap you'll see that it has components in either direction from it. Haphazardly checking to only one component may send you into a long period of T-shooting unnecessarily. Always check both ways on a trace for continuity as shown by the black diamonds above for the ground side of C412.

Well... was that all that was wrong with this checked & rechecked chassis? No. One last problem that is shown in the above pic. R517 is shorted to ground! If you look at the lower leg of this resistor you'll see a solder splash that connects it to ground at C412 on the trace. That's all it takes & appearance can be deceiving. You see it & think that it does not touch the adjacent pad... don't believe what you think you see... clear away any solder splashes no matter how harmless they look.

K... before I forget, I mentioned the old plugging in the monitor without an isolation xformer trick & if you're lucky, the only damage you'll have will be one of the bridge rectifiers being blown out or shorted. These diodes are located in

positions D901 thru D904. If it got past the bridge, I'd look at the regulator next & beyond that it's a hunt & peck job :-(

I wanted to mention the horizontal width coils here, also. Most are discolored & brittle at this stage... if original... but still usable if they are not broken completely off during the handling of the chassis. Quite often the chassis is placed upside down on the work bench without thought to this coil & it actually stands in for a leg... no pun intended :-)... & it snaps under the pressure. Since the mfr of these coils is up in the air right now, caution should be taken to preserve the one you have. After a couple of price increases on the repros of this coil the mfr decided that it wasn't profitable enough & quit making them, so until someone picks up the slack you should take care with it as though it could not be replaced.

Well... I guess that about covers the things that went wrong during a cap kit installation on this particular chassis, along with some other thoughts that I had, and if any new installation problems arise in the future I'll do my best to get them added here... time permitting. Seems like I only get to play with these pages on holidays :-)

PostScript: I do have one tip I should place here that has helped at least 70 people get their dead G07 back on it's feet when a cap kit & flyback didn't produce a working chassis again, even though the flyback was split open & caps were visibly shot. The tip that saved these from the maul was to remove & check resistor R908, a 47K ohm 1/2watt resistor, that often drifts way off value... anywhere from 5K to 500K to open... from the added strain placed on it by the bad flyback, and often times by the shortcutter that jumps his blown F901 with a jumper wire :-(These shortcutters usually end up getting a real surprise the first time a flyback explodes it's body with a sharp earsplitting retort! Sometimes shortcuts come with repercussions :-(

Additional Notes

I've taken in a second chassis to see what went wrong & will relate that here hoping it will help others, as well as, guiding another future tech. I guess this one will have to be named Jon Doe to protect the innocent :~)

Overall Jon did a very good job of installing the G07 repair kit & all caps were installed correctly... a few "high-water" jobs, but not too bad... and he had replaced several components that typically do not need replacing, but in this case even the new replacement components were again fried :-(

First quick checks showed these components to be bad including some that he had replaced. The HOT (X01), regulator (X04), xsistor (X901), and resistor (R903) were all toasted & the shorts that caused this were pretty easy to find as they were man-made. The first had to do with the replacement of the HOT. Take a look at the pic below:



You can see that the arrow is pointing to an insulator under the T03 (-: bottle cap :-): transistor, the HOT (Horizontal Output Transistor), and it is there to insulate the bottle cap from the frame metal. The one in this pic is a rubber one that I don't particularly like since they dry up, crack or burn with the combination of heat & age, often times shorting underneath where the naked eye cannot see it. I prefer the mica T03 insulators which I have found to be still intact in 1940's restorations. Forgiving even when cracked from mistreating them... most still insulate without incident. Well... a piece of paper would have worked better in this instance, since the insulator was still stuck to the original HOT that had been replaced. Metal to metal on these just doesn't work. You need to reuse your insulator if it is still good, or replace it

if you are uncertain about it being good. If your heat sink compound (white stuff) is still pliable on the insulator it is probably enough to reuse in this instance, but if you are replacing it with a new one you should put a dab of compound on the insulator & use it to stick it in place before mounting the HOT. The compound aids in transferring heat to the frame where it dissipates keeping the xsistor cool. Note: Do not touch this HOT while the monitor is powered as you will quickly learn the second meaning of the word "hot"... as in can-bite-you live!



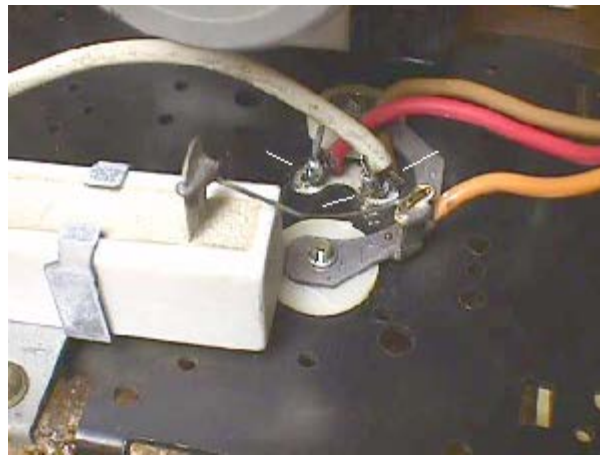
This was not the only short between the HOT & the frame. The flip side was also shorted in 2 places to the frame. The pic above shows the flip side and when soldering the leads back onto the legs you should solder them near the ends. In this case, the leads were at the bottom & shorting to the frame.



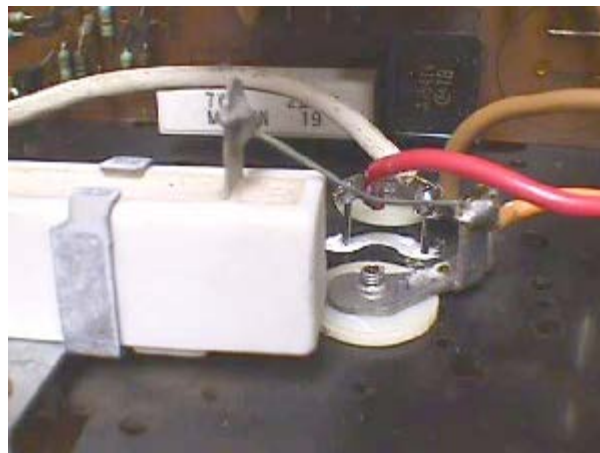
The leads should be as in the pic above... well above the frame... and I personally prefer to ball the joints. Not all techs do this, but I've always thought it to be a good practice & something I picked up from doing lots of high voltage soldering. Balling the joint is nothing more than adding solder to the joint when you have finished the installation, trying to make a ball of it as best you can as voltage can arc from any pointy places on your joint to ground. You don't want to reheat the joint running the new solder into the old, but rather like setting a ball on top with just enough heat to bond it to the old. Your 5KV focus line... on the focus block & on the neck bd... are good examples of where you really need to do this. I've seen HV find a path from just the end of the wire sticking out from the joint to ground, leaving a charred path that resembles a termite trail.

K.... so what to heck was crisping everything in the voltage regulator circuit??

The answer was exactly the same as the HOT, which came as no surprise. If you didn't know to insulate & keep the leads soldered high on the HOT, why would you know to do so on the regulator xsistor. I did grab a pic of this before replacing it, so that you could see how not to do it & it is below:



You can see how low the leads are & where they make contact with the frame. Not only did the solder come in contact with the frame, but it was also heated enough to run down to the case of the bottle cap, much like an icicle hanging from the eaves, making for yet another unwanted grounding point.



This pic is after installing a new regulator, T03 insulator with heat sink compound & with the joints soldered high up on the legs of the transistor.... balled, as well :-)

So... Mission accomplished, how does one do a 24 hour burn-in on this chassis without tying up the jig... providing you have one to begin with ?



Well... here's one quick way. I simply took a plastic milk case & turned it upside down & placed it over the xformer assembly in my clunker Ms Pac cab as it had a G07 installed already. All I needed to do then was set the repaired chassis on the plastic case & move all pertinent connections from the chassis in the cab down to the chassis below. Made setup a cinch & the chassis passed burn-in with flying colors without tying up the workbench or jig.... and under normal game conditions.

All in all... Jon Doe did a decent job & had this page been here already, he'd have done an excellent job... well on his

way to techdom :-)

Happy Gaming...

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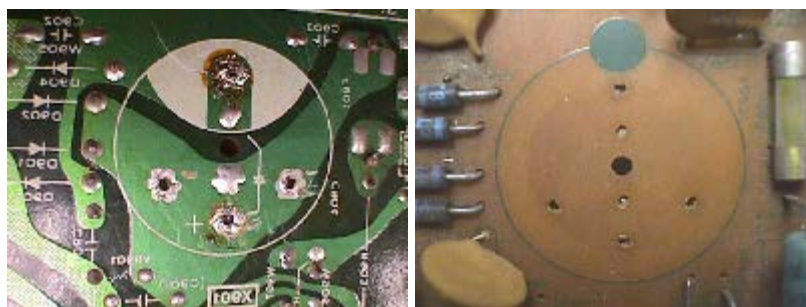
G07 Chassis

Changing The Filter Cap

by Bob Roberts

Here's another one of those things that I keep repeating myself on, so I figured as simple as it is to do, it still deserves a place here on the BBBB & it shouldn't take very long to do at all. I'm referring to changing the B+ filter capacitor (C904) on the Electrohome G07 chassis that so many ask about. Some of you know it too well, having met up with it during a cap kit job where the fuse F901 was blown, paying no heed to discharging it & ending up in a shocking experience :- (You might take note to always discharge it before attempting to work on the chassis just to be on the safe side. This cap filters the B+ voltage as it leaves the bridge rectifier and during normal operation bleeds off its charge via the components on the chassis when shut down. If your chassis has a short that causes F901 to blow, it isolates the cap giving it no discharge path to ground, so when you brush against it in removing the chassis..... surprise! You provide the path to ground for it to unload it's charge :- (

Sooo... let us say that the first step to changing this capacitor is, to be on the safe side and discharge it to ground! You can short the 2 center terminals together with a screwdriver blade or simply use a jumper with alligator clips to direct it to ground.



Unsolder the 4 terminals of the existing cap, which appear to form an arrow pointing down in the pic above left. If you look at the lower 3 terminals you'll see that they all solder into the same pad on the chassis bottom. The two outside terminals are actually stabilizers for the cap due to it's size.



Since we are going to be replacing this one with a new modern one, which is much smaller in physical size, we will not need to stabilize it. In fact, we

won't be using any of these 4 holes for mounting the new cap, so go ahead & fill them in with solder & open up the 2 thru holes closest to the center. The new cap will be utilizing these holes maintaining the same polarity... negative to the top & positive to the lower pad that once held the stabalizers.



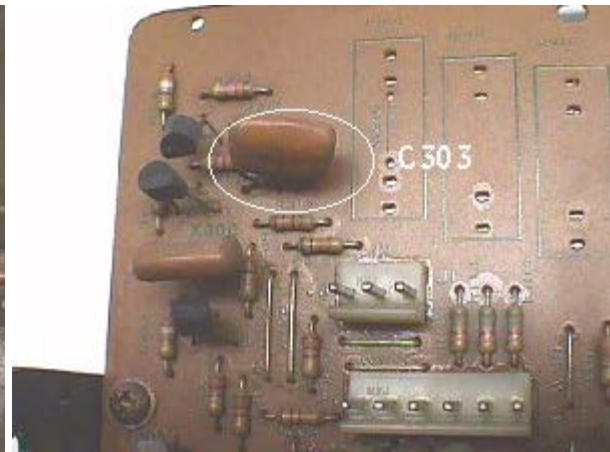
Hopefully, your completed project will look like the above pic. Yes... you won't be able to find a 600uf 200v cap, but the 680uf 200v cap of today will fill in nicely.

Happy Gaming...

- A Couple G07 Notes -

The first thing is the mod to the G07 chassis that upgrades the sync circuit to handle the newer PCBs eliminating top curl in the pic. The way the instructions were written seem to be hard for some to follow, so I'm going to put my own notes on it as posted in RGVAC in 1998 here & hopefully they will be easier to follow. To make the upgrade do this:

- -First.. remove C501 & chuck it out.
- -Second.. remove C303 & place it in the holes for C501 & solder.
- -Third.. clean the solder from the hole between the 2 holes where C303 was removed & fill in the one furthest from the chassis edge with solder.
- -Fourth.. put a 10 to 22uf @ 25 volt minimum in the now closer together holes at C303 with the longer positive lead going thru the hole closest to the edge of the chassis PCB & solder.
- -Fifth.. after reinstallation of the chassis adjust the H hold for a center point without the curl.



Obviously, if there is an electrolytic already in the position for C303 & the cap at C501 looks like the C303 in the pic above, the upgrade has already been installed. The post-installation is pic'd below.



Next is the original G07 chassis [G07-CAO](#) and the installation of a cap kit. This uses the same cap kit as the [G07-CBO](#) with the following changes:

- 1. C517, which is a 470uf 16v cap will be replaced with the caps from the kit marked for C517 (100uf 25v) & C518 (220uf 25v) at the now unpopulated site of C518. This is a parallel network which adds to total 330uf 25v across the side pin xformer T503 and since it is parallel, it makes no difference if you mix up the two positions so long as you install them with the correct polarity. Hint: Both ground sides will be closest to the flyback xformer. Note: Electrohome warned about replacing these 2 caps with a single larger value cap in any of their chassis'. This 2 cap bridge should always be used on any G07 version.

- 2. C302 (220uf 25v)is not used.
- 3. C407 (4.7uf 63v)is not used.
- 4. The extra cap used for upgrading the CBO version's sync will not be used.... C303 (10uf 50v).
- 5. C301 (3.3uf50v BP) is not used since we include them in our kits.
- 6. C520 original BP cap is upgraded to 3.3uf50v BP.
- 7. C511 (47uf160v) if it still has an axial cap you'll need to install a radial.

So you should have 4 spare capacitors from the kit to have on hand for the next project that is almost certain to need one of them... well, positively if you did not have them on hand... isn't that always the way it happens :-)

Thanks to Bryan Kruzynski for supplying a lot of info to work with here.

GO7-CBO Shrunk Pic

by Bob Roberts

Yet another project started that I will gradually add to. I'll try to go through all the adjustments, setup, part nomenclature & case histories of failures, time permitting. For the moment, I'm going to start with a question that has been asked & answered at least a hundred times in different variations...

My pic is too small vertically.....
My pic is not wide enough.....
My pic is too small all around.....
My pic is too far right.....
My pic is too far left.....
My pic is black at the top.....
My pic is black at the bottom.....
My pic is just a square in the center....

The first thing you need to do is install a cap kit because the caps in the horizontal & vertical circuits may have changed value, developed high resistance shorts or simply opened up, and your chances of getting a perfectly formed pic are slim to none.

Once you have installed the cap kit, the next necessary step is to be sure that you have a 120 volt DC B+ power supply to the monitor. If this voltage is low, it will result in a pic termed "postage stamp" which is black on all sides. If it is high, you may be able to shrink the pic to the proper size using other controls, but this higher B+ voltage raises havoc with the rest of the circuitry & will most assuredly cause other premature failures, so it is important that this be correct from the onset.

To adjust the B+ for 120 VDC you will need to clip your ground lead of your meter to the metal frame anywhere, and the red lead to the end of R01, the large white sand resistor mounted on the left side of the chassis frame as in the pic below, on the furthest terminal with the white wire attached to it. If your voltage is off the 120 mark you need to adjust R909 as shown in the pic below, until you have an exact 120 volts DC.

Next locate the jumper wires at the rear right of chassis & labeled H. CENT & V. CENT. With the power off, pull these 2 wires & place them on the center terminals if they are not already there.

NOTE: For the purposes of adjusting you may have to turn your screen control up slightly to define the edges of the pic. When finished, turn back down until background illumination has extinguished into black...just beyond the disappearance of retrace lines in the pic.

Locate the width coil L503 at the front right of the chassis as pic'd below, and insert a plastic 1/8" hexhead alignment tool into the center. Power up the monitor & using a mirror or sidekick & EXTREME CARE not to get a good shock, adjust the pic until both sides no longer show any black. One side will always fill before the other, so just keep turning until both are just eliminated & not too far off the edge.

Locate V. Height (Size) control approximately center rear of the chassis as pic'd below. Adjust this to show black on the top & bottom of the pic if it is not already black in both places. Now adjust the V. Lin beside that control for an equal amount of black at the top & bottom of the screen. Once you think you have it equal, go back to V. Height & open it to fill the screen out more. If you see that as you get close to entirely filling the screen, you have a larger amount of black at either top or bottom, simply go back to the V. Lin & adjust for equal amounts again & then open fully with the V. Height control.

2003 Insertion

Your G07 is vertically challenged... what to do?

This seems to be a very common problem & one that I write about over & over again, so I picked this spot to inject a little permanent help. Sometimes in handling the chassis to do a cap shotgun, one can accidentally break one of the vertical output transistor's legs. There are two vertical output transistors mounted on aluminum heatsinks middle/right on your chassis. There are many subs for the transistors, but if originally equipped, the number stamped on them will be D1138. The legs sometimes break just as they enter the plastic housing & this is very hard to see unless you apply a small amount of pressure on the heatsinks while looking at the transistor to see if a gap opens up. Remember, this may be the way that the transistor broke in the first place, so take care not to use an undue brute force that will make this a self-fulfilling prophecy :-(If you are familiar with testing transistors in circuit you can check these, but you want to check them from the solder pads underneath. This will confirm a complete circuit to the actual transistor. Just as the pressure can snap the leg at the body, it can also pull a leg free from it's solder pad making for an open, or intermittent connection, at best.

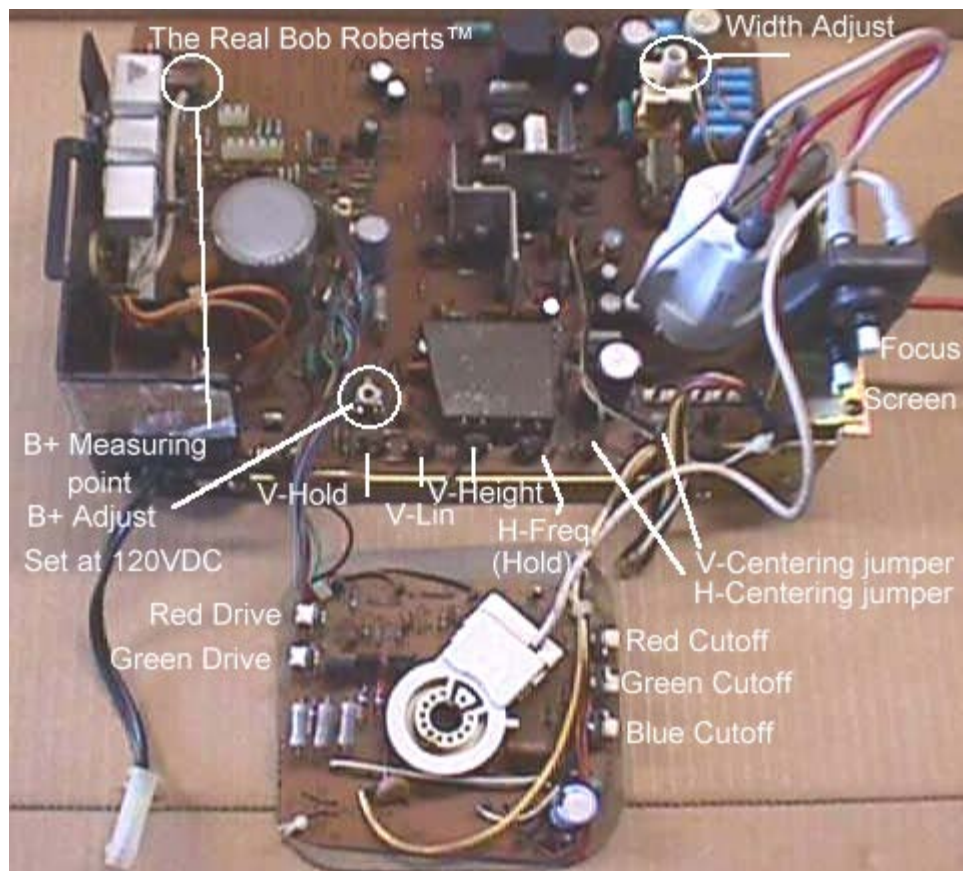
K... now that you know what is happening, here's a good tip for after shotgunning the caps. You should routinely inspect & touch up solder joints, anyway, but knowing that these vertical outputs can pull loose from their solder pads or break from the case, it would be prudent to remove the old solder from the legs and after making sure that none have fallen away from the body, resolder them with fresh solder before reinstallation of the chassis.

K... I didn't ramble enough :-(Well... let's try this :-) Unwanted tip 202:

The chassis is what many of you call the monitor frame while calling the chassis the monitor board. The chassis is the PCB which is housed on the monitor frame along with the picture tube & other associated components. The cross member that the chassis actually bolts to is called a chassis pan. Jeez... I have room for one more...ummmm...
Pronunciation Tip: "Solder" Sodder & not sold-der.

Now you can look at your pic checking for centering. If it is too far right or left, up or down, simply move the corresponding jumper wire from step 1 that will put it closer to where you need it. Not an exact science...it is an adjustment that you look for the best possible results & not necessarily perfect results.

If you followed all these steps & still cannot achieve a full pic in some way, you have a component problem in the circuit that is not producing the results you are looking for.



Happy Gaming.....

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- When Everything Else Fails -

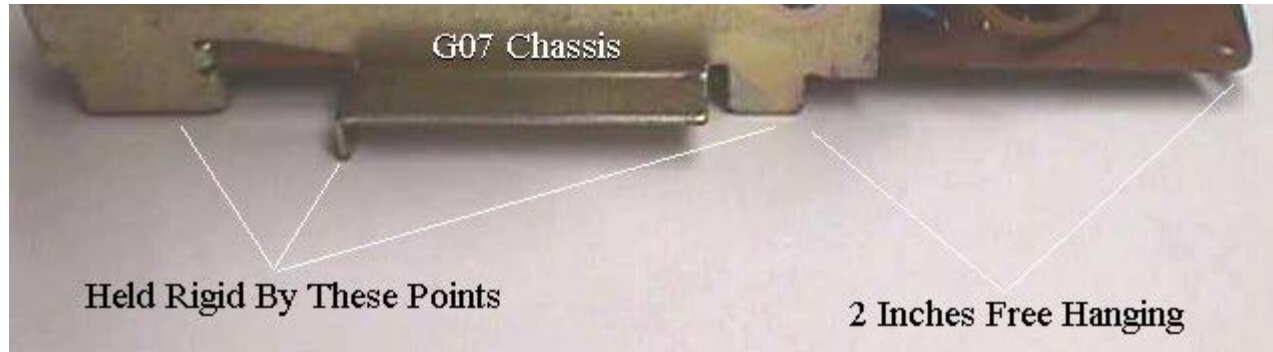
Here's a tip of last resort when you've rebuilt your G07 chassis & it's still dead when you reinstall it. This one came about years ago when ops were sending in G07 chassis' for repair & in the beginning I noticed a few instances of them being reported dead on arrival periodically. Each case ended up being the same... cracked PCB & after the third one was returned I discovered that it wasn't a shipping accident as previously thought. After finding the cause a caution sheet accompanied every G07 chassis that left the shop. Over the past 10 years it has helped many a hobbyist that has run into this stumbling block and asked for help, but I failed to post it on site, so I will put a copy of it here now before I forget & maybe it will be beneficial to others.

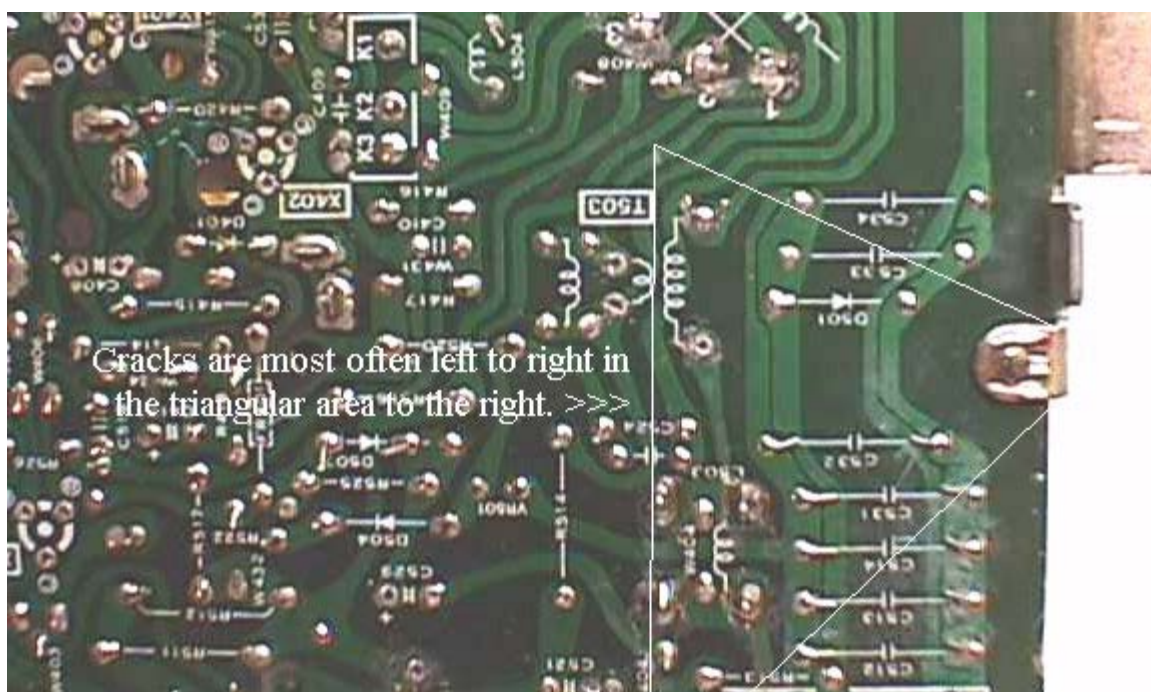
Dang! It's all in caps! Maybe that's why I've been dragging my feet :-(It's only a few lines, so I'll just type in here as it appears:

G07 Installation Caution

This chassis has been inspected for PCB breaks & found to be sound in every respect. For years there has been a problem with operators reinstalling these chassis' & cracking the PCB from one of the front screws that hold the transistor heat sinks. These heat sinks hold the back 6 inches of the PCB rigid, while the front 2 inches is kind of suspended in air. This and the stiff upright tabs sticking up midway that hold the PCB to the frame, do not allow the back of the PCB to give in any manner. Now if you look at the front of the metal frame you will see 2 spring tabs sticking up to hold the front of the PCB in place. When installing the chassis you must guide & watch these front tabs that hold the PCB in place. What often happens is that the PCB slips up over the top of these spring tabs & since the back cannot move at all, the PCB cracks right at the end of the right frame.

The advantage here is that I can add a couple pics that should help.





Cracks are most often left to right in the triangular area to the right. >>>

I'm sure many of you have seen jumper wires on the bottom side in this area & now you know why. Another crack site is anywhere in the circumference of the flyback pins & this comes from not completely removing the solder when changing one & prying on the old one to get it out. Spend the time to resolder a pin several times, if necessary, in order to get a pin completely free from the PCB. This is true when removing anything soldered in.... when the solder gets old & doesn't want to evacuate the mounting hole adding new fresh solder will meld in with the old making it easier to remove.

Hopefully this will save someone from scrapping a good G07 chassis...

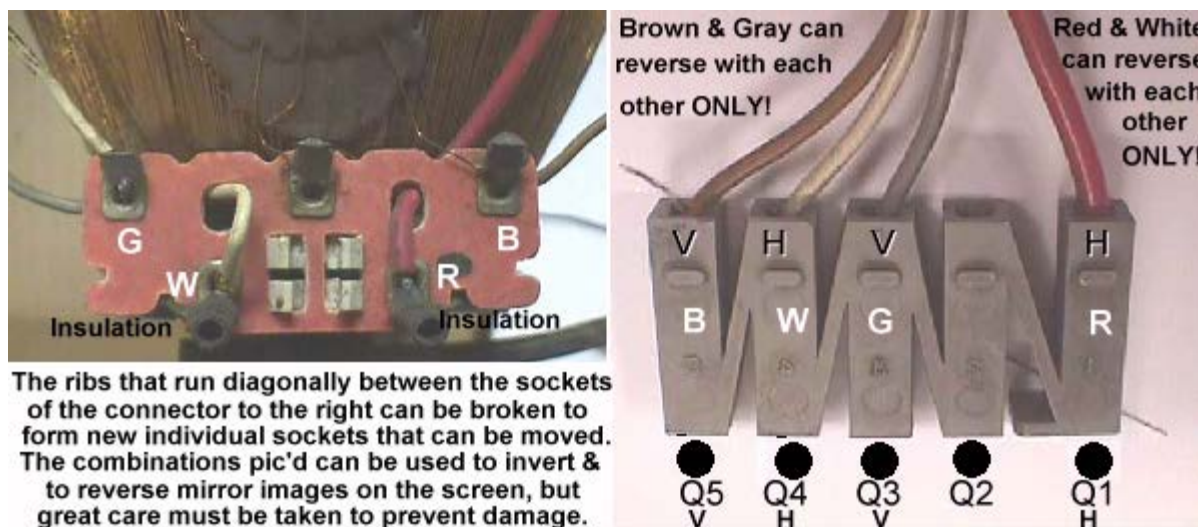
Happy Gaming...

[The Real Bob Roberts™ Site Index](http://www.therealbobroberts.net/g07note.html)

Yoke Flipping

by Bob Roberts

I'll expand on other yokes in the near future when time permits, but for right now I will put this 1st self explanatory pic here as a start. Well...I guess it does need a tad more info :) This is the yoke & it's plug for the Electrohome GO7 chassis connections with color coded break down.



Red & white are the horizontal winding & can be reversed if pic is mirrored & the same for the brown & gray wires which are the vertical winding, but no other color combination can be made without serious damage being done to the monitor in a split second.

You should note that there is a blank post as many a tech has brought in a monitor with horizontal or vertical collapse only to find they have missed a post & used the air post for one of the sockets.

There are a great number of sites where you can find out how to use a switch to flip on the fly, so I won't go into that except to say that I would use 2 separate switches as some games require only the vertical or horizontal to be flipped while the other remains in the same position. I would also make certain to have the red & white connections insulated to prevent hot burning shocks if accidentally touched.

UPDATE:

Taking a bit of time today...5/9/00...to expound a bit on this topic, as many have difficulty with flipping their pics when changing games. About 75 percent of other yoke plugs are going to be more straight forward ... some will be gray, and others black, but the wiring code will remain the same as follows: red & blue horizontal winding - green & yellow vertical winding. ALWAYS check with an ohmmeter to be sure that the color code was followed, and that someone has not previously changed wires around. You will get a lower reading on the horizontal winding, and typical ranges are from 2 to 12 ohms on the H winding & from 12 to 60 ohms on the V winding.

The next thing to look for before any changes are made, is a parallel header in the vicinity of the yoke header & plug. Many of the imports from around the world use dual, crisscrossed headers, whereby you can simply unplug the yoke and move it to the adjacent header to reverse images.

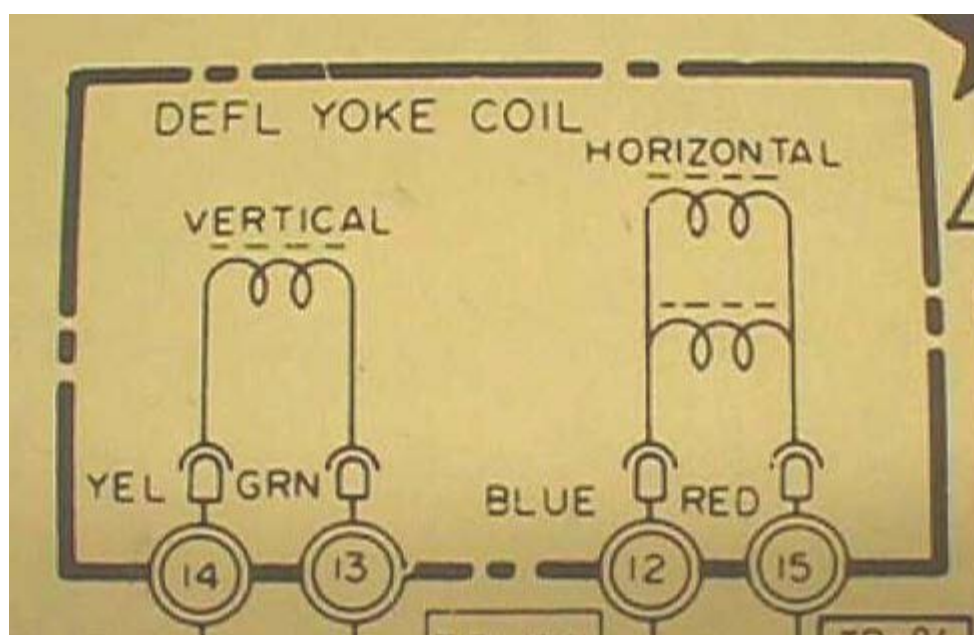
Okay. You've checked it all out & know you can't flip the pic with the pcb's dip switching, and you have no alternate header to select, so here is the next easiest, quickest way to invert your image/s. A typical yoke plug will look like this pic ...



... and if you cut it down the middle, making two separate plugs, you can then reverse either plug giving you the option of changing one or both images; mirror & upside down. Unlike the staggered wiring of the GO7 yoke, other yokes kept the windings' pins side-by-side usually, and with a wider gap/spacing between the H winding pins to prevent you from plugging up to the wrong winding.

Update 3/25/04

Many people still have trouble with the yokes, so I'm going to try to get it a little more basic using laymenese. The pic below shows the yoke as found on a schematic. The looped lines are the electrical symbols for a coil. A coil (inductor) is one of the most basic components in electronics and is nothing more than a piece of wire wrapped into a number of turns on an iron core, wrapped on an insulator (non-conductor) of some sort, or even shellacked into a free form that is self supporting. If you were to take a 20" piece of wire & wrap it onto a pencil in a number turns you'd have a coil. More or less turns & the thickness of the wire will determine the value. The yoke coils adhere to this same simplified principle even though they are intimidating in their huge interwoven bell-like patterns.



The horizontal coil above is pic'd as two coils in parallel & the vertical coil pic'd as one actually should be pic'd as two

in series, but regardless of how many coils are used, you only need view them as two... the horizontal & the vertical. If it helps, slice right down through the block above and push these two coils apart, as they are two entirely separate coils. Standard colors are written in to ID the two coils, but so many times the colors are just whatever the mfr happened to have on hand & this seems to trip a lot of you up when trying to determine which of the 4 wires go where... and you already know you don't want to mix them up! If you take an ohmmeter and measure from position 14 above to position 12 or 15, you can see that your meter is not going to do a thing... open circuit... as it will be from position 13 to either of those 2 positions. The only way you're going to get a reading is by being across two of the positions that represent the two ends of the coiled wire, so it's fairly simple to match up the 2 pair of wires for each coil. If you have "Fruity Pebbles" wire colors on your yoke it would be a good idea to jot down the colors of each pair. Now to flip the pic that you actually see on the screen all you need do is reverse the wire colors in a pair... above vertical winding would be equivalent of taking the wire from 13 & swapping it with the end that is on 14. It's as simple as that & if you want to determine which coil is horizontal & which is vertical, then just read your ohmmeter when you are determining the pair & the larger reading of the two will be the vertical winding, while the one that nearly shows as shorted will be the horizontal winding.

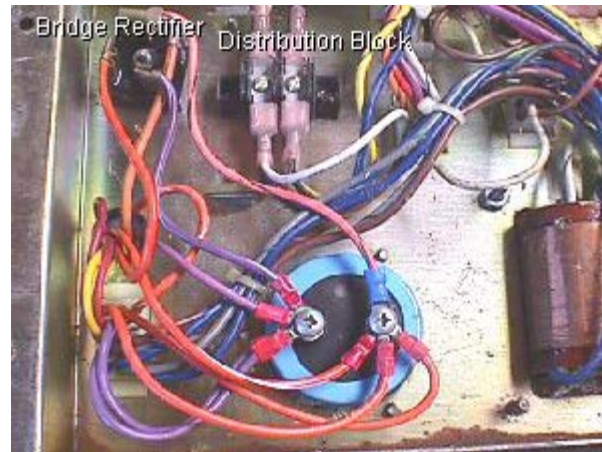
Happy Gaming.....

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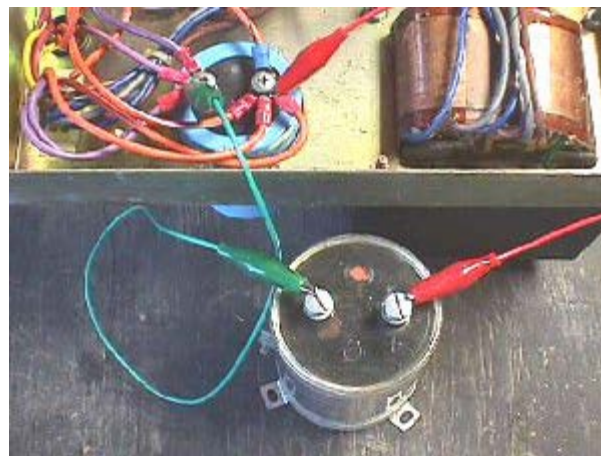
- Good Cap - Bad Cap -

FAQ How can I check the Big Blue cap to see if it needs to be replaced?

In MHO the very best way is substitution because the results are absolute and, in this case, it is almost certain that it is due to be replaced. Short of substituting, when you think this cap may be the cause of your problem, or any filter cap, for that matter, there is an inexpensive way of quick testing them by bridging across them with another electrolytic with similar uf & voltage ratings. The Big Blue values used were 26Kuf, 27Kuf or 28Kuf rated at 15 volts, so ideally you'd need something in the range of 25Kuf to 32Kuf at 15 volts or higher to bridge across the existing cap for testing. Actually, anything in this range would be fine as a permanent replacement, as well. The basics are to jumper in the test cap by using two alligator clipped leads making sure to follow proper polarity... positive to positive & negative to negative (lest you receive a big surprise)!



I'll do this the long way, so that you see what is going on & then give you a shortcut afterward. In the pic of the underside of the Atari xformer assembly above I marked the bridge rectifier because this is another Q that is asked pretty regularly... where is it located? I also added the + & - symbols to the Big Blue. As you can see, the orange wires go to the + terminal & the violet wires go to the - terminal.



K... this is for illustration only as I have just barely clipped this 28Kuf15v cap in. I use these premade jumpers because they are more forgiving if you make a mistake in any hookup & will usually pop open right at the clip before any serious circuit repercussions occur. If you're using them for a permanent tester I would suggest using crimp-on ring terminals & color coded jumpers... black - & red +... leaving alligator clips on the business end only.

If your symptom goes away with the bridge then you need to replace the Big Blue permanently.... don't try to leave the bridge in as a permanent repair! This method is true in other circuits, as well, whether it's looking to cure an audio hum, a bar roll, a weave or a postage stamp pic. One **caution** is that since an electrolytic does store up a charge, you'll need to

leave it hooked up a few minutes after powering down the unit under test to allow the cap to bleed off the charge. You can also do this by clipping it across a 1K to 2Kohm 5 watt, or better, resistor. It's good practice to discharge the test cap with a resistor in this manner before using it to test a cap & if multiple caps are tested, after each use, so that a stored charge is not released into a circuit where it may destroy a component.

Usually, when the filter has lost capacitance it is just less than needed to prevent your symptom, but it is not completely dead, either, so your tester really doesn't need to be ideal in uf value as long as the voltage rating is at least equal to that of the cap being tested. If all you have handy is a 10Kuf15v cap it may very well be enough to bring the capacitance up enough to let you know that replacing Big Blue will cure the problem. Conversely, if you had a 10Kuf15v filter in a linear power supply that was acting up, you could bridge it with the 28K15v tester or any Big Blue to see if it was the source of your problem. Again, never leave a bridge in... it's just for a temporary quick test.

K... I said I'd give you the shortcut to testing a Big Blue.... one that can be used in many situations. Since these are filters to smooth out your supply voltage you can usually look at the schematic for a point that is electrically the same, but in a more convenient place to test. In the case of Big Blue, it filters the 10.3VDC supply voltage to the A/R (audio/regulator) board & a quick look on the A/R bd shows that there are test tabs for both 10.3VDC & ground, so clipping in thru these tabs saves from having to unbolt the xformer assembly to get at the Big Blue terminals. Of course, if it proves out bad you have to do this anyway, but if it's not the cause of your woes you've saved a little time.

While I'm here I may as well show how to replace Big Blue with a larger physical sized cap. This is something that often has to be done with the Midway suitcase PS. It's a little easier with the Big Blue as the assembly has plenty of room to mount a larger cap, so that mounting remotely in the cabinet bottom is not necessary, but nonetheless, still an option. I know that a lot of you are looking for a cheaper way to replace these Big Blues since the new ones keep climbing in price. Like so many other things these days, no one stateside wants to mfr them :-)



The first thing to do is disconnect the terminals of the Big Blue on the underside, then remove the 3 screws holding the mount to the framework... saving the screws. Next... set a 2½" cap & mount over the opening... center it & mark the 3 holes with a permanent pen & then drill them using a 1/8" bit. The same self-tapping screws will go right back in the new mount.



Rotate the cap so that the + & - are in the right position & tighten the mounting clamp to the cap.



Flip it over & replace the wires on the cap terminals & tighten them down. Using these mounting clamps you can mount a cap upside down in a cab bottom & run wires to any circuit that needs a filter.

Multi-value caps.....



The large metal multi-value cans are nothing more than what their name suggests... several electrolytic caps in a single housing using a common "can" ground. Yes... you can bridge across these when testing, as well. If you find a bad section, but are unable to find a replacement cap with all the values, you can bridge in a new axial or radial single unit, whatever you have room for, however, you must clip the leg of the bad section, eliminating it from the circuit. If you use an axial cap you need to cover the legs with spaghetti or heatshrink tubing to prevent any nasty shorts from occurring. If you find yourself without either insulator for the legs you can use the insulation from a piece of scrap wire. Supposing you found "B" to be bad on the cap pic'd above... 200uf100v... you could replace it with today's common cap

of 220uf100v, or better, in either a radial (both leads coming out the same end) or an axial (lead coming out of each end) cap.

The cap I used for bridging is available on the [Parts Page](#) along with several other values that could be used for testing purposes. There is also a box of good used [CG caps](#) on the Specials Page that would come in handy for testing a variety of caps.

Happy Gaming...

- Great 1000miles Rally Notes -

This pcb uses the basic Jamma connections plus a few extra connectors. There are 2 connectors on the lower board...a 6-pin and a 5-pin. The 6-pin is for connecting a 360° steering wheel. The pinout is as follows:

- 1 nc
- 2 nc
- 3 + 5volts
- 4 clock
- 5 up/down
- 6 ground

In order to use a 360° steering wheel you must put dip switch 1 on at the 4 position dip switch located next to the header connector & dip switch 4 on / 5 off at the 8 position dip switch located at the pcb right side.

The pinout for the 5-pin to connect up a 270° steering wheel is as follows:

- 1 + 5volts
- 2 potentiometer
- 3 ground
- 4 nc
- 5 nc

In order to use a 270° steering wheel you must put dip switch 2 on at the 4 position dip switch located next to the header connector & dip switches 4 & 5 on at the 8 position dip switch located at the pcb right side.

When using the 270° steering wheel you must center it. To do this, align the wheel to straight ahead position & hold the start button down while powering up the game, and wait for screen to say "wheel adjusted".

8 position dip switch functions:

- 1 normal mode / test mode
- 2 screen flip
- 3 cab type UR / CT
- 4 joystick control off / steering wheel control on
- 5 360° wheel off / 270° wheel on
- 6 on no brake button used / off brake button used
- 7 used in conjunction with 8
- 8 both off=flags & national anthems / both on=none / 7 on=anthems / 8 on= flags

Test mode....dip 1 on....choices are "input device check", "system setting" & "sound test". Use start button to select your entry & use accelerator button to change.

Input device check is the standard I/O check for testing buttons & wheel.

Systems setting is for adjustment to coin/credit, difficulty, language, flags, anthems, & clearing game records. Any changes made must be saved before leaving via selecting "memory the setting & exit".

Sound test is obvious with the exception of sound on demo mode. To toggle the sound in demo mode on & off you need to press the start button & the accelerator button at the same time.

Greyhound Poker/Trivia Pinout

Lately a lot of you have been requesting info on Greyhound gaming boards, so I guess interest in having a Poker or Trivia game in your collection has been increasing. Pinouts are often sought after, so I'll place them here for your convenience.

Greyhound Poker Pinout			
PARTS SIDE		SOLDER SIDE	
Not used	1	A	Stand Switch
Not used	2	B	Cancel Switch
Not used	3	C	Deal Switch
Play Credit Lamp	4	D	Discard 5 Switch
Discard 1 Lamp	5	E	Discard 4 Switch
Discard 2 Lamp	6	F	Discard 3 Switch
Discard 3 Lamp	7	H	Discard 2 Switch
Stand Lamp	8	J	Discard 1 Switch
Cancel Lamp	9	K	Not used
Deal Lamp	10	L	Not used
Discard 5 Lamp	11	M	Not used
Discard 4 Lamp	12	N	Not used
Lockout Coil 2	13	P	Coin Switch 1
Not used	14	R	Coin Switch 2
Token Motor	15	S	Token Switch
Not used	16	T	Total Switch
Not used	17	U	Knockoff Switch
In Meter	18	V	Not used
Out Meter	19	W	Test
Token Meter	20	X	Play Credit Switch
Lockout Coil 1	21	Y	Not used
Ground	22	Z	Ground
The Real Bob Roberts™			

Main PCB Power Pinout

Molex Inline Connector	
1	+ 5 volts
2	Ground
3	Key
4	Speaker
5	Token Switch

6	Token Motor
7	Ground
8	+ 5 volts
9	Panic
The Real Bob Roberts™	

Main PCB Video Pinout

Molex Inline Connector	
1	Vertical Sync
2	Horizontal Sync
3	Ground
4	Green Video
5	Blue Video
6	Red Video
The Real Bob Roberts™	

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- Microswitches -

What's the common for?

FAQ - Where do I hook-up the wire for the common terminals of my microswitches?

With an influx of newbies to the collecting world come some of the most basic questions that we all take for granted.

The answer should be self-evident on my Help Page [here](#):

Basically, you run a ground line from your edge connector ground & loop all the commons into it & then back to your starting point, attaching it to an adjacent ground position in the edge connector, so that if one connection to ground fails the other will keep the integrity of the ground circuit. You can also terminate your loop for each line that you run since it would be obvious as to the location of an open ground line by the area in which your switches do not function. For example, I always run a separate ground line for each of the following areas...

in the video bundle, the coin door bundle, player 1 bundle, player 2 bundle and for the speaker...so any switches used for player 1 controls are in a loop of their own from the first switch to the last switch & back to the start point on the first switch. If any one ground loop breaks it will still make contact in the opposite direction & if all switches fail in that loop I know it is between my first switch & the edge connector... the only lone common ground wire & easily identified by the junction of 3 black ground wires - in from PCB, start of ground loop & the closing ground loop wire. A *lasso* arrangement, so to speak.

The other question that usually accompanies this one is, "What size wire should I use to hook them up?"

Wiring other than the 18ga power conductors should be done with 20ga whenever possible & 22ga when you just don't have the 20ga that you need. Anything smaller than that is just a pain to work with & maintain. It might be fine for your thermostat wire in the attic of your home, or in the phone lines in your wall or any other app where the wiring is not exposed to us humans & has screw terminals for termination of that smaller wire, but right out here in the real world where we have to come in contact with this wire & utilize it for crimping, soldering or even the el cheapo push-in connectors... it just doesn't wash :-(Cabs used to swap in & out multiple PCBs don't stand a chance with the smaller gauge wires considering the amount of times they must be handled. The only thing I could think of that could be worse, would be using solid wire in place of stranded wire in game use :-(Now that's not asking for trouble, it's begging for trouble :-(

Replacement Jamma harnesses in their infancy tried to skimp on wire gauges & brought barrels of grief to buyers & techs alike. Wires pulling right out of the connector housing.... overheating power terminals... burning edge pads... having to crank the switcher open to full bore in order to bus the 5 volts to the components on the PCB... intermittent connections..... open connections where the insulation actually fooled you into believing that the wire was still connected by hanging onto the terminal saddle... and a parcel of other misadventures along the way to destinations via intra-cabinet break connectors.... CP, coin door, video & etc. To add ease to the demise of a connection, quite often the paws of even this *Big Bear* would sometimes snag a wire and yank it from it's home while removing or installing some component :-(

Troubleshooting Gun & Monitor

Here's a list of commonly found problems & there possible solutions compiled for Lethal Enforcers, but can be applicable to most gun games.

- **Erratic gun shot placement.**

-Check to see that there is no reflected light from fluorescent or neon lights bouncing off of the screen. Strong sunlight also affects the shot placement.

- **You cannot shoot a certain area in the screen.**

-Check to see the monitor's purity with red, blue, green, and white screen in the "COLOR CHECK" in the Manual Test. If you find purity problems, you should degauss the monitor.

-Check to see there is no magnetic equipment around the cabinet. This may also cause the monitor to become magnetized .

-After degaussing the monitor, you can check the gun and monitor in the "GUN CHECK" in the Manual Test.

- **Screen flashes when trigger is pulled but no shot is made.**

-Check to see the gun lens inside of the barrel is clean.

-Adjust the monitor's brightness with 'color bar screen in the "COLOR CHECK" of the Manual Test.

- **CLEAN MONITOR AND MIRROR REGULARLY.**

HOT or Output Transistor on Fire!!

by Bob Roberts

Here's something that popped up back in 2006 first & I noted it on one of my Pages. The second time it came up was 2007 & I was not able to find where I had posted the problem onsite, so I tagged it onto another Page. As it has come up over the years I remembered it & relayed the problem through email. Rolling around to 2013 I missed what very well may be another case of this problem in an email request for help :-)

Well... however small the chance is of repeat problems, I believe it is time it had it's own Page that is easier to find... short as it may be, here goes:

The problem: Changing the HOT or an output transistor & upon powering up flames shoot out & fuses blow.

The problem as described by quite a few of y'all via email reports:

1 "It turns out that the "high end" thermal compound I have started trying to use on G07s has some capacitive properties (Arctic Silver), and today when I got the HOT mounted, I essentially got fire from around the pins (even though they were not shorted)."

2 "My flaming problem on my K7000 turned out to be some junk silver compound I bought from RS. It carries electricity better than my wiring!"

3 "Found my xy arcing problem. Arctic Silver 5 thermal compound was bad."

4 "The adhesive I used was grey(Radioshack--thermal) small 1oz tube 12 bucks! rip off..." ... Used it on XY HV Diode!

5 "No more firepit! It seems Radio Shack sells some compound that is known to carry current!"

6 "Heat compound I bought from Fry's was the problem & I need new cables to the frame mounted transistors now as it is all caked in the holders. Can you help?"

Well... there you go... short & sweet, or bittersweet, as it were. My advice.. stay away from any compound with the word "Silver" in it!

Happy Gaming...

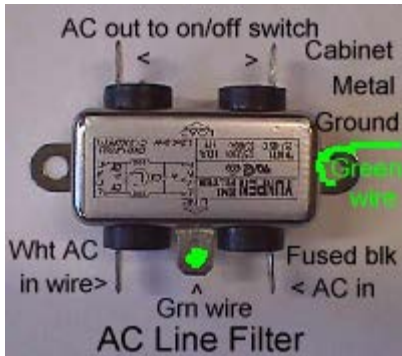
I Want To Build a Game!

by Bob Roberts

I have an empty cabinet. How do I put a game in there? Newbie question of the year 1998. Hmmmm....here's a rough idea of the things you'll need for a Jamma cabinet & what is involved in wiring it up. Just the very basics instead of a detailed, in-depth version laced with technical jargon.

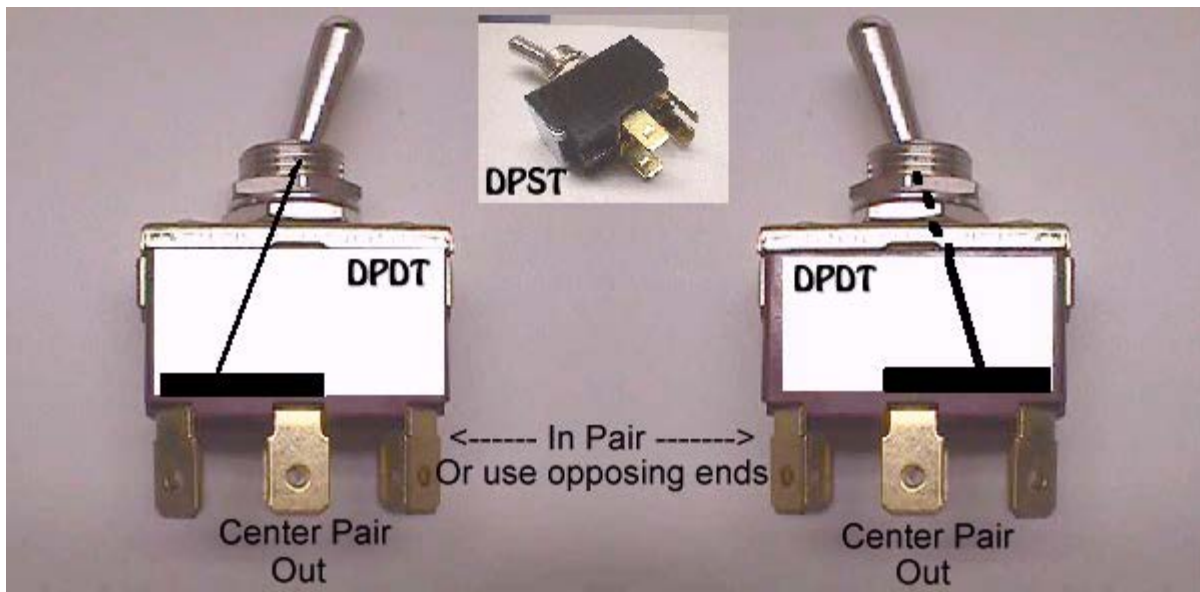
You'll need some 18ga wire to wire up the AC portion of the game first, after you have laid out a plan as to where you are going to want everything placed. I'll start off with the 10' or longer AC line cord. Fish it through the hole in the cabinet designed for this purpose & secure it with a cable clamp leaving enough line to run to your AC filter.

Ok! We have 110VAC into the cab and now we need to fuse the hot side & put an on/off switch in line. Run the neutral wire & the green ground wire from the line cord directly to the AC filter inputs making sure that the green wire is connected to the metal case of the filter, either with the internal connection if it is a wire type, or the case tab if it is a quick disconnect type. (This is where your ground line will begin to tie all the metal in the cab together...just run a braid or 18ga preferably green wire from the metal on the filter to the power supply, coin door, control panel [metal] and monitor frame.) The hot side of the AC cord can now be fed though a fuse holder with a 3 amp fuse in it, and on to the other side of the AC filter.



7/4/2 Addendum:

Several questions are arising on a daily basis now... more than a FAQ... so I will insert the answers here as another paragraph to save time. The first one is in regards to what size fuse to use in the AC line & it should be as stated above, but I guess overlooked a lot for some reason, as a 3 amp fuse. This only needs to be a standard fast/quick blow fuse of 125VAC or better. Next is in regards to whether or not a second fuse is needed in the neutral line. You can certainly fuse both lines if you want to do so, but it is not necessary. This sort of pertains to the next question, as well, and that is to do with switching both hot & neutral lines. Again, you certainly can if you so desire, as did many game mfrs... in fact, they also switched both lines through the safety switches in many cases... but simply switching the hot side as in your common household light switches is perfectly acceptable. The switches used in games are Double Pole Single Throw (DPST) & essentially this means that you have 2 switches in one case that are both either on, or off, at the same time when toggled. There are 4 terminals on this type switch... 2 on the end & 2 in the middle... and you only need to use one end position & one middle position. The switches are independent inside the case, so the exposed terminals do not pose a shock threat to you, however, there are also many DPDT (Double Pole Double Throw) switches in games & this is where a few of you are having a bit of trouble :- (This switch has 6 terminals (poles)... 2 center & 2 on each end... and a basic way to look at these switches would be as though you cut the body in half right down the center, long ways, creating 2 separate & independent switches. If using one side only, you are still safe from exposure to a shock on the UNUSED side! Depending on where you hook your fused hot line, it is possible to have 120VAC on the exposed terminal when the game is switched off. I'll tell you how this can help you after, but for right now I'll try to explain this as simply as I can. Maybe a pic is order:



OK... OK... stop laughing at my drawing :-(Y'all know that I can't even spell ARTIST :-)

My attempted drawing is suppose to show you what is happening inside the switch & you can see that if you ran the hot lead coming from the fuse to a center terminal that it's resulting output would be switched to one or the other end terminals ALWAYS! This would mean that the input 120VAC would be feeding the game when in the on position, but when in the off position it is feeding the exposed bare terminal. This can cause your eyes to open widely if brushed against while poking around in the game that you think is off & safe! The remedy is, of course, to feed the input to either end using the center to feed the game. The exposed terminal is no longer a shock threat.

FAQ: In most of my games the earth ground ends at the AC filter & does not tie the metal cab parts together. What's the deal here?

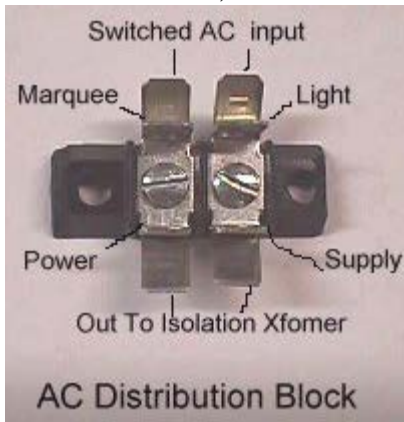
Yes it's true that inert cab metal grounding is often nonexistent or it has the CP excluded due to minor shocks between games when one is improperly wired... it has the monitor frame excluded due to herringbone interference presenting itself on the screen... it has the PS excluded due to chattering &/or interference, and there are many varying opinions on this within the industry & all I can say on that is that any shocks that I have gotten from inert metal vid game parts since their inception, has been from earth grounded pieces. I have never received a shock from an inert vid game metal part that was not tied to earth ground!

Oh... before I run off, I had said I would tell you how a DPDT switch could be used to your advantage in a cab. Over the years there have been many hobbyist that wanted to put 2 games in one cab, but totally independent (less monitor sharing) of each other & this is an easy way to accomplish just that. First you need a DPDT switch that has a center detent for an off position... standing straight up in the center will be the off position for both games. Simply wire the hot side from the fuse to the center terminal that was taboo in the single game cab, and jumper it through to the other center terminal... making for one entry into both sides of the switch. Now you'll have 2 hot outputs on each end of the switch. Using one side of the switch you can supply either game in the cab with a switched hot depending on which way you toggle it on... you know, the bare terminal that was going to shock you in the single game cab can now be supplying the input for a second game instead of laying in wait to surprise you :-(K... you still have a hot terminal on either end of the switch (same side) & this is used to feed the isolation xformer it's hot so that it can be shared for both games. Both of the remaining output terminals on the switch should be connected to the hot input of the iso. What this accomplishes is that when your switch is in the off (center) position the iso is also off, but no matter which game you flip on, the iso will be getting a hot feed, as well. That only leaves actual vid/sync sharing & sometimes just feeding both to the monitor input works fine, but to keep them isolated as separate games you can insert 1N4007 diodes in each line (cathode toward the monitor) before it goes to the monitor input header as blocking diodes preventing any feedback when combined. This is easiest to do by making up a "Y" connector with the blocking diodes inserted into it. Then you can plug each game's vid/sync signals into your "Y" & plug it into the monitor header with no resulting hacks to be undone in the future. Sharing a CP, if both games are similarly controlled, can pretty much make this a flip of the switch transformation.

We now return you to your regularly scheduled program :-)

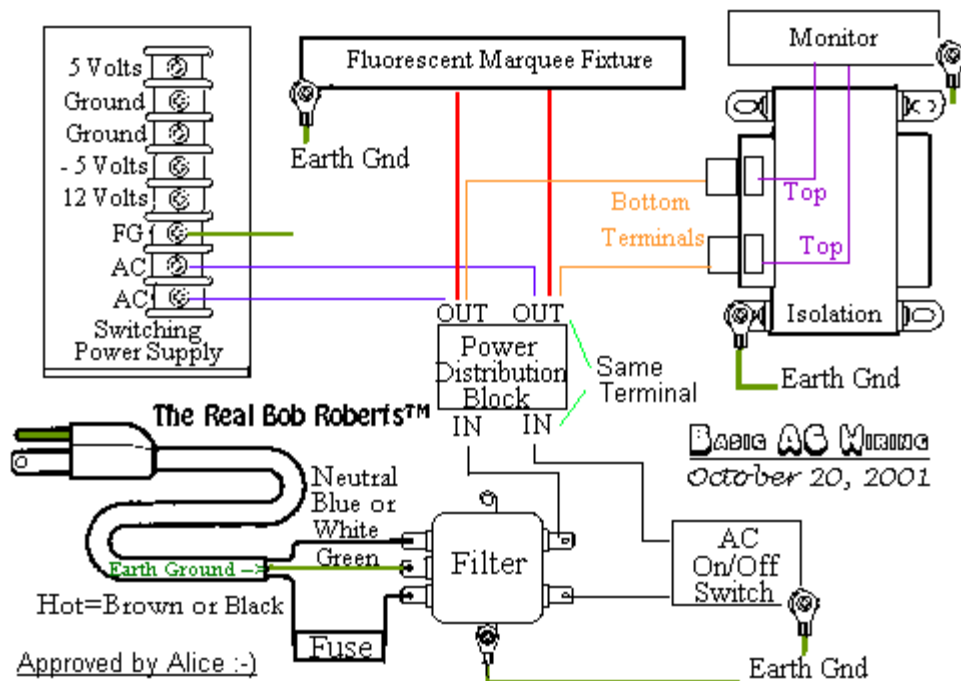
On/off switch...I always located these on the the top righthand side of the game for convenience purposes....some mfgers had them at that back-bottom-middle-impossible-to-get-at position, and I just couldn't stand that. Run your 18ga wires from the AC line filter output tabs to the power switch.

We have a fused, switched & filtered AC line at this point & need to route your AC to the needed destinations. The easiest way to do this is to have an AC distribution block with .25 quick disconnect tabs....4 on each side. Run your 18ga AC wires back down from your power switch to this AC distribution block & utilize .25 QDs to attach them to the terminals, one on each side. Now you have 3 terminals on each side left to use. Use the first pair to supply AC over to your switching power supply....the second pair will be used to supply AC to the input of the monitor isolation transformer...and the third pair will be used to supply AC to your marquee fluorescent light. Remember, you have passed the input of this distribution block, through your on/off switch at the top of the game, so when in the off position, there is no power being supplied to this block, and therefore all things attached to it are now off.



To finish off the AC portion of wiring, you will need to run a couple 18ga wires from the monitor isolation transformer outputs to the monitor AC input and you should be ready to Jammataze the game now....the easy part! Before you go on, if you want, you can plug the game in and power it on for a few seconds to verify the power supply LED lights & the marquee lamp & just listen for HV voltage build up in the monitor. Do not leave powered more than 15 seconds or so... just enough

to let you know you are on the right track, and not long enough to damage the switcher with no load on it.



Hmmm...you're right on track & the switch turns everything on & off, so now I'd start with one of the many \$10 to \$20 Jamma pcbs & mount it where you have planned to have your pcb located & attach your Jamma harness to it. The first step is powering your pcb with DC voltages, so you will want to run the power wires from the Jamma harness over to the switching power supply. The typical generic harness has 4 to 5 feet of wire and since your pcb is where you plan to keep it, cut the power wires to have a minimum of slackness to them.



The shorter the run from the pcb to the power supply, the better. I like to keep them under 30" long & terminated with spade connectors with a minimum of 3 18ga wires for 5 volts, 3 for ground, & 1 each for 12 volts & -5 volts.

Ok, so without going into a couple more pages of details, we basically have DC power to the pcb, so lets run the easy one next. Mount your speaker, if your empty cab didn't already have one in it, & run the Jamma speaker wires to it, preferably with a plug in line for disconnecting it separately.

Next run your Jamma monitor connections...RGB, gnd & sync...up to the monitor input header following the pinout for the monitor mfg. The basics are in place now, and you can go ahead & power it up for a smoke test at this point, making sure that any loose wiring is not laying on the fuse block or across the pcb or other place that might cause a short.

You're at the decision point at this time. If you adjust your power supply's 5 volts so that you have 5 volts on the test pcb's pads, and you have a good picture & sound, if the pcb is set for attract mode, you're good to go to the next stage, and if not, perhaps it's time to buy a Jamma cab :(

Everything is down hill & real easy from here, beginning with running the Jamma wires for the control panel, which you should have already populated with the joysticks & buttons of choice, by now, and running the wires to the coin door for coin switching & any other options you choose....coin meter....coin lamps...test switch....credit switchetc. I always used a safety interlock switch & mount for a test switch as some games require only a momentary close of the switch to go into test (push it in like the back door of a game) while others require the switch to be on all the time you are in test mode (pulled out like on the back door of a game while you are working on it).



If you want coin door lamps and/or coin meter, you can run a 12 volt line from the Jamma harness to the coin door for this purpose, but make sure that these are also 12 volt lamps &/or meter.

This should get you started in the right direction without getting into too much technical detail.

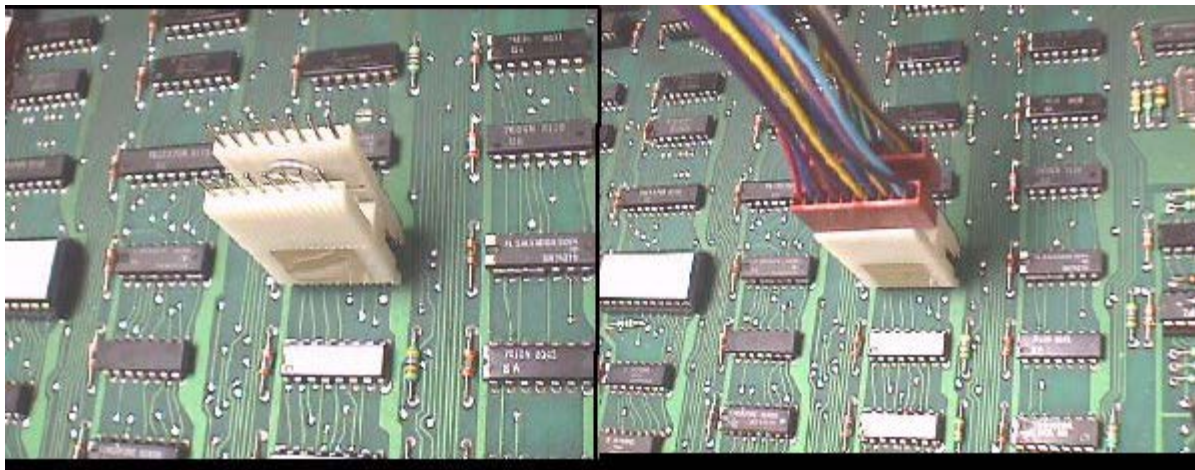
Happy Gaming.....

All the parts pic'd here are available on the [Parts Page](#).

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Uses For IC Test Clips

by Bob Roberts



**The IC Test Clip Can Be Used For Safe Access To DIP Leads
It Can Be Used To Aid Removal Of DIPs From The Board
.100 Connectors Will Plug To Them For Many Remote Uses
So Many Requests For These That I Located More
We Have Limited Quantities Of 14-16-20-28-40 Clips**

These IC test clips come in handy for dozens of uses & I'm going to toss out a few of them along with some pics. The first use is as it's name depicts... an IC test clip as pic'd above left. Clipped onto an IC that you want to take measurements on it facilitates access with probes from meters, scopes, logic probes, pulsers or other equipment & helps prevent shorting in those tight locations that PCB mfrs love to come up with.

The pic above right shows how you can use wired .100 connectors as extensions for various uses. You can use these to your advantage since they slip on & off without damage to the IC test clip to suit your particular testing needs.

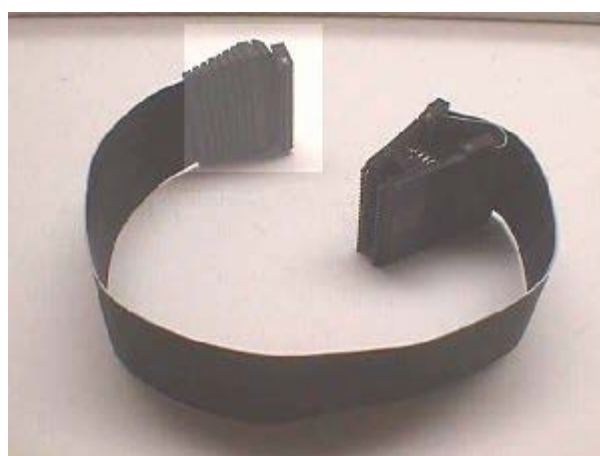


You can make up cables with larger connectors than you really need, so that you can use

them on any of the IC test clips up to 40 positions by just letting any unused positions hang over the end. You only need ensure that both connectors start with the pin 1 position.



You can make permanent cables like this one which goes from a 40 pin dip header to a soldered in place 40 pin IC test clip. This was used in places such as the Z80 on a Pac bd that hides under a riser bd. After removing the Z80 & plugging in the dip header the test clip can be clipped to a Z80 on a dummy bd or even on a Ms Pac sat bd that has a cardboard backing on it.

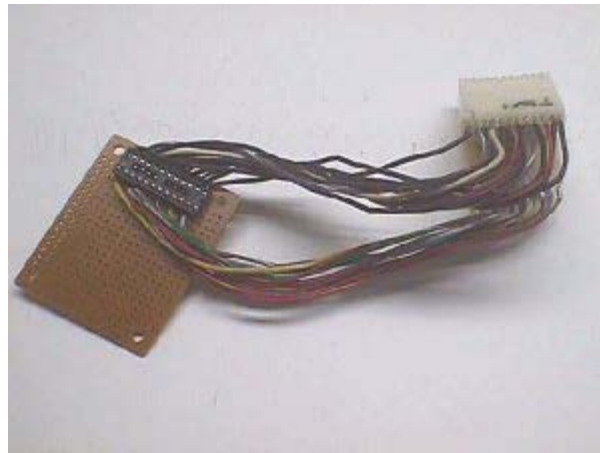


This one goes from a 40 pin header such as found on WMs games out to a 40 pin IC test clip via .100 connectors.



Using a pair like above you can sub in a suspect IC from a dummy bd or I've had a few techs over the years that would drive me crazy by just letting the known good IC free hang from

the clip. Using a dip header you you can also extract information from soldered in eproms for your programmer.



Another way to use these is to mount an IC socket on a dummy bd as pic'd above. You can add a ZIF socket to top it off for quick & easy changing of ICs.

There are limitless ways you can use these as testing devices for specific jobs you need to accomplish. Throw in a handful of resistors & a handful of LEDs & you can have a visual of what is going on with an IC under test.

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Ice Cold Beer Fix

by Bob Roberts



Here's one that comes up every 2 months without fail...where do I get replacement belts for my Ice Cold Beer?

I tried everything under the sun on these type machines in the beginning, and the best replacement I found, that is permanent, can be found at any corner auto parts store & many Wal*Marts & other discount stores. The last one I did myself, was on location about 10 years ago. They were all stretched out & unusable, so knowing the answer I just cut the belt on one side...the barmaid almost passes out...and I ran it across the street to an auto parts store & picked up 2 pieces of windshield washer tubing the same diameter & length as the piece I had cut off, plus a blister pack of 4 plastic ribbed couplers. Walked it back across the street & installed the new ones in about 5 minutes. If memory serves me right, I think I got change back from a five dollar bill. I remember it as being real inexpensive, at the time.

The last time this came up, about 6 weeks ago, I called the location to ask how the machine was holding up...the reply was just fine & never another problem with it. I asked the owner if he had to readjust them any over the years, and he

said he hadn't touched it. The reason that this is so permanent, is that if they were to stretch again, you simply pull the union apart & snip off a half inch & put it back together.

I've repaired many of them before that time & many after by proxy here locally. Not as many or as often as in the NG, but at least once a year someone will still call or drop by and ask me for the belts, giving me the opportunity to explain how windshield washer tubing works. I've never had a repeat customer with that complaint.

Happy Gaming.....

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Lighting Up Your Pac Buttons

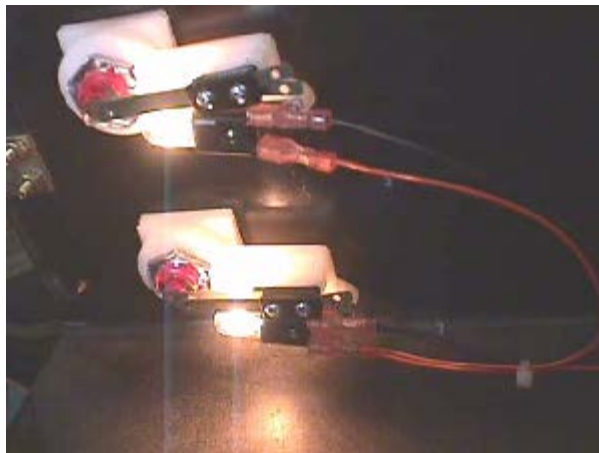
by Bob Roberts

Quite a few people have asked for help in lighting up their start buttons, most notably on the Ms Pac-Man CP & since they were pleased with the results, I've decided to offer it as a kit to save time & make it easier to do.... maybe less intrusive, as well. Red translucent buttons seemed to be the choice for most, so that's what I used for the kit. Of course, you can adapt the kit to other games, also.

Note: For you puristic collectors, please stop reading at this point :-()



Basicly, this is just a couple of complete new button assemblies with lamp holders & lamps attached, plus the lamp wiring to tap into a power source.

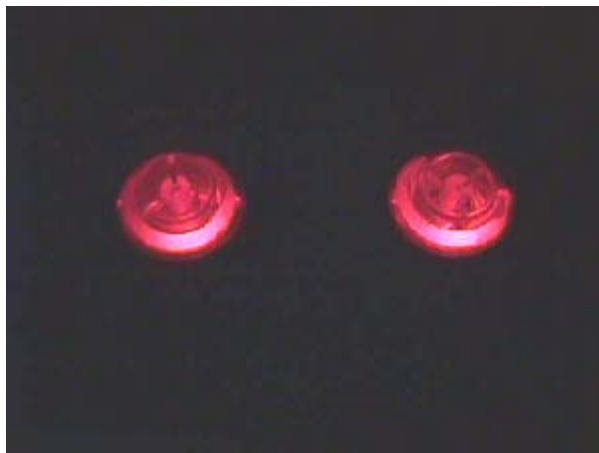


I've added the 12 volt wedge type lamps that will operate from either 12VDC on the DC Pac harness or on 12VAC from an original AC Pac harness. You could use 555 lamps & wire into a 5VDC power source in the cab if you wanted, but Ive always chosen the 12 volt option to keep lamps off the logic bus supply.



Although polarity is not a factor here, I've color coded the wiring to standard black for ground & orange for 12 volts & added a couple inline splice connectors to make it easy to tap into your source voltage. If you are more advanced in wiring you might want to combine this feed with the feed to the coin door connector. The coin door lamps are fed through the 9 position Amp connector, used as a line break, at positions 5 (blue-yellow) & 7 (yellow-green), so you could extract those 2 Amp sockets from the board side of the connector & add one of the lamp feeds with each one.... new socket... and pop'em back in. I would add a 2 position connector in the feed going up to the lamps, so that it could be disconnected when removing the CP from the cab. For the real wiring ace, a couple Amp pins & sockets would allow you to use the existing CP break connector by utilizing a couple of the empty positions. Just one neat break plug & the CP is removable.

If you are using the inline splicers you can tap into the two wires as described above... blue-yellow & yellow-green for your lamp power. You'll have to transfer your switch lines over to the new leaf switch, too. The old switch wires are soldered on & now would be a good time to add quick disconnects to those lines making for a neater & more practical way to attach them.



They really glow at 4:00 AM in the morning :-)



I'll bet they look a lot better on a freshly covered CP....



Happy Gaming...

In regards to what I have been saying for many years pertaining to cutting the long 3" Atari roller shafts down to fit the Wico or Imperial trackballs... it has finally been confirmed possible by Adam Pletcher. Here's what he had to say, "So it turns out, if you cut off 1/8" or so from the two Atari rollers with a dremel they fit the import TB units perfectly. The wheel screws even still fit. I just marked it next to the old one and cut." That should help many of you & my guess is that you could probably accomplish it with a hacksaw if you don't own a Dremel, as well.

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Isolation Transformer Repair

by Bob Roberts

Here's another of those common hindrances that has been around since we started buying imported isolation transformers back in the 80s & I guess it is destined to be around for many years to come. I think I have bought isos from every company selling the imports & it doesn't seem to matter if they were made in Mexico, China or any other country, they all seem to have this common thread that bonds them together, or not ;-) [No pun intended!]

I call this the **alarm clock syndrome** as that is essentially what you have... an electric alarm clock buzzer in its most basic form. If you've installed more than a couple isos I'm sure you have been jumped out of your shoes at some point in time by this syndrome. You get your iso all installed & plug the game back in only to hear a loud buzz... sometimes deafening... and you quickly unplug it & wonder what on earth you did wrong! Well... you've made an alarm clock buzzer during installation or perhaps the iso took a hit during shipment & was already one when you received it.

The alarm in an alarm clock is a buzzer... for this instance, anyway, and what is a buzzer? A buzzer is nothing more than a piece of metal (called an armature for those who would like to know) positioned over an electromagnetic field in such a way as to vibrate it producing a **buzz**. Great to wake you up in the morning at a specified time, but when you're doing a smoke test on a new piece of equipment it can be quite inappropriate to say the least.



The pic above shows where the case is tacked to the laminates... the body of the transformer... by the elemi that bonds the laminates & when one side or the other breaks free from this tack, well, you have the armature just lying in wait, readying itself for you to give that transformer some power to make the electromagnetic field that it is missing.

As I said, a good thumping in shipping will break one of these free & that is why I open every case that comes in & remove each & every iso & inspect it. If it's solid I place a piece of Styrofoam across the front where the terminals are... another thing that is easily damaged in transit... and then wrap them tightly in bubble for reshipping. This gives you the best shot at not starting with the alarm clock, but the number one way that this event spawns is through the mounting procedure. This can be from using oversized screws... too large for the diameter of the mounting hole & something has to give... or it can happen with the proper size screws if they are to the outside of the mounting holes. Once the first screw is in toward the outside of it's mounting hole it leaves no slack & is unforgiving when you go to the outside of the second screw's mounting hole, as it puts pressure akin to a wishbone at Thanksgiving time on the case & quietly separates it from the body.

In building games, on a bad day, I have made as many as 6 alarm clocks myself, so I know it is easy to do, especially when using these large battery driven screw guns that hug & bump the xformers during the mounting procedure. If just one side breaks free you can simply remove that side & angle the screw toward the body to tighten it back in place. If you break both sides it is time to remove it & repair it because it is not going to tighten sufficiently to prevent all buzz.



Pic'd above is one that I broke the tacks on... very easily by just tapping a small screwdriver's blade in between the case & the body. Incidentally, I did power this one up on the bench in the state you see it. It buzzed & vibrated so loudly that it startled me even though I was expecting it, vibrated a pair of pliers from the bench onto the floor and it brought Alice running.... "you've finally blown something up, haven't you?"



Here it is without the case on it & you can see the the tack points a lot better & how little of the resinous material is actually holding that case in place. Below is the removed case & you can also see how clean & free of elemti that it is, other than at the tack points.



I guess you've figured out by now that I am purposely breaking this xformer so that I can show you how to put it back together. When I have to put them back together I use GC's Radio Service Cement, but that is kind of expensive for a one time repair, so for this one I asked Alice to pick up some cheap glue at Wally*World (Wal*Mart) for me to try. She brought me back change from two bucks & the product pic'd below which, quite frankly, I had doubts about, but it actually did as good a job, if not better, than my more costly regular cement.



It looks like a big tube of toothpaste, but it's really a pretty decent adhesive. I was accustomed to using the applicator brush built onto the cover on the GC product, so I just used a 1/4" china bristle brush to paint the adhesive where I needed it.



I actually painted up a little higher than I usually do... going up about 1" on each side where I usually only go approximately a 1/2". Next... slide the case back on all the way.



I like the Quick-Grip tool as pic'd above for holding these in place & put it near the top whereby I can place it on a hard surface to tap the tabs back into place. To do this I use a little kid's hammer... something that is indispensable around the shop... when Big Bertha is definitely not the tool to use :-)



Once the tabs are tapped into place you can add a tad more adhesive if needed. I don't know if this next step is needed, or not, but I figure it can't hurt & it might help. I turn the xformer on the side & brush a little adhesive into the open 45s at the top corners as pic'd below.



Now we are ready to bake it & the oven has to be set at 350°.... no... no... that's another project! :-) For this one all you need do is let it stay clamped together overnight or whatever your particular adhesive instructions say.



Don't have the Quick-Grip... here's the alternative... a standard bench vise. Your xformer is going to be so quiet that you'll wonder if it's on! It IS, so don't touch one of the terminals as a test :-)

I recently had an EE tell me that he thought his xformer was defective because he thought it was the laminates separating under the case. I'd never seen, or heard of this in practice before, so I took the liberty of removing an old one, popping it open & then using the same small screwdriver that I used to open the case, I split the laminates apart in several places. I powered it with no case... no noise, buzz or otherwise. Then I replaced the cover with no adhesive & tapped the tabs back down & powered it once again. It was quiet without doing anything to it until I tried to pull one side away from the body, at which time I got a low buzz. I went ahead & applied the adhesive & clamped it up overnight. The next day when I powered it up it was as quiet as the new one.... and I didn't touch a terminal to check for output :-)

I've seen a few cases of the alarm clock syndrome in older games after they have been transported from one location to other. Nowhere near as prevalent, but nonetheless it does occur.

Happy Gaming.....

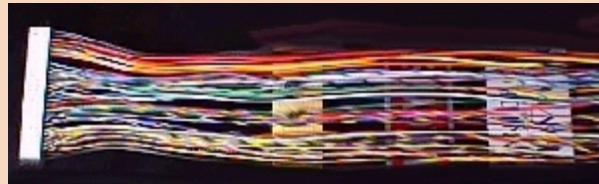
Isolation transformers can be found on the parts page below.

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What To Do With Your JAMMA Harness

By Bob Roberts

I've been waiting to do the Ms Pac-Man rework to show from start to finish on the DC wiring of a cab, but there are just so many new entrants to the hobby that need the help in this basic area that I thought their pleas could wait no longer. I just took one of my basic replacement Jamma harnesses, freshly made, and continued with it by simulating cab installation... as you would upon receiving it... and snapped some pics along the way.



What you'll receive is 54 five foot lengths of wire all pinned & inserted into a Molex 28/56 housing. It is keyed to prevent you from plugging it up to your PCB backwards, ergo 54 wires & not 56, since the key utilizes 2 adjacent positions. The other end of these 54 wires is stripped... prepped for attachment... but totally unterminated. The housing is labeled, so you know what each wire is for. On one end you'll have 12 power wires all to one side of the key. These are 18 gauge wires to easily handle the current flow and are color coded, as well as, being labeled. The black is universally recognized as ground, with red being associated with +5 volts, orange as 12 volts, but the -5 volts is one that is not so agreed upon & consequently may be blue, yellow or brown depending on who's color code is being used. I try to use the color that fits into my overall color scheme when making harnesses, and in this case, for JAMMA, I use yellow 18ga for -5 volts. The remainder of the wires used as I/O are 20 guage.

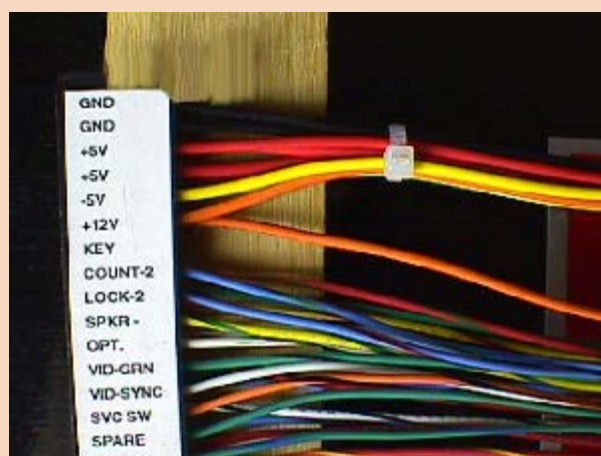
The first thing you need to do with your harness is bundle it. As all of you that have bought my Pac & Galaga harnesses already know, bundling consists of making 6 primary bundles of wires that will stay together to their destination. They are:

1. *Power*
2. *Audio (Speaker)*
3. *Video-Sync*
4. *Coin Door*
5. *Player 1 (Controls)*
6. *Player 2 (Controls)*



Let's start with those heavier 18 gauge power wires. In the pic above you'll see that I bundled only 11 of the 12 power wires leaving out one 12 volt lead that will be used later. Gather up the 11 wires & cable tie them about 2" to 3" from the housing. From then on you should have a cable tie approximately every 4" or one hand width apart seems to be the easiest way. You don't want to complete your cable tying yet, as you don't know how much of your wire is going to be used in each bundle, nor where your connector breaks are going to fall, so 2 to 3 more cable ties is sufficient for now. This should hold the first 12 inches, or so, together & on the very end of the wires you can put a temporary cable tie to keep the wires from straying. Actually, I use wire harness labels to keep them in line & always know what the bundle is for. You could use white tape out on the end & do the same thing by writing the destination on the tape.

The pic below is a closeup of the power end & shows the bundle a little more clearly.



Ok... The next one I'm going to tie is the coin door bundle because I am going to utilize that leftout 12 volt wire from the power bundle. It is to supply the 12 volts to the coin door for lamps, meters, bill acceptors, coin lockout coils or whatever accessory you might want to put in your cab. Eleven wires are going into this bundle & I'll briefly mention them & why, if necessary, and I'll put a list afterwards with their harness label position as it reads on the actual housing. The second wire that I'll pick up is ground & I get asked many times about grounds, so I'm going to break this right here & try to clarify the ground issues.

[Here goes Bob rambling again]

First question in one form or another is *"How does the CP ground tie into earth ground?"*

Well... it doesn't. Having said that, many mfrs did tie their *logic* ground into *earth* ground, but it is not necessary & in some cases can present problems that wouldn't have been there save for the tying of the two grounds. What the earth ground is used for is to tie all inert metal parts... casings, bolts, coin doors, framework & such to earth ground... yes... just as you think it is... earth ground as in outside into the ground in your garden :-). This is accomplished by looping all metal together & then into the grounding prong in your AC line input cord, ultimately tying into your power entry box outside your home at which point it runs down to a rod driven into the ground.... hence... *earth* ground! This is why you always hear people saying to change your AC line cord if someone has cut off the grounding prong on the plug. The link to your garden has obviously been interrupted in those cases:-()

Logic ground is ground in reference to your DC power source... your 5VDC, 12VDC & -5VDC... whether it comes from a linear power supply, switching supply or plain old battery power! No, it's not like your automobile where any metal surface is actually grounded, so you can't run a wire from your coin door frame up to a switch on your CP looking for logic ground & expect it to close the circuit for you.

Just one more seed for this garden before I get back on track. Quite frequently I'm asked how the ground from one end of the Jamma harness is tied to the power supply on the other end & the answer to this CAN be related to your automobile scenario above. The PCBs ground traces are all linked together on both sides of the board, so any place that is designated as ground on the PCB, is just that, *logic* ground, and unites all logic ground into one common termination back to the supply grounding point at your source of DC power.

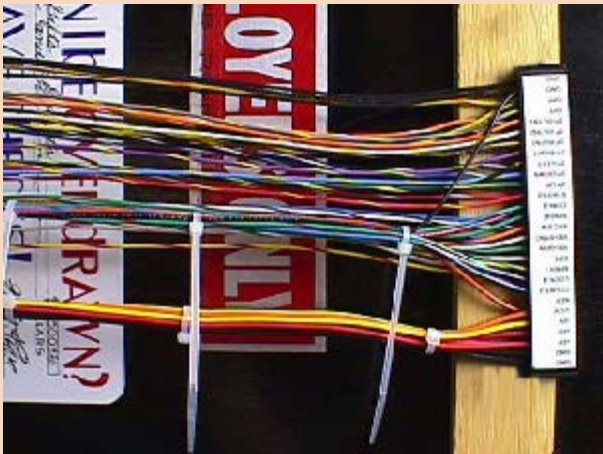
[Struggling to get back on track]



Ok... We have 2 wires in this coin door bundle so far, 12 volts & ground. Next we'll add in the coin counters (meters) for both coin entries, 1 & 2, and also, the lockout coil wires bringing us up to 6 in the bundle at this point. Now I know a lot of you are saying that you have no intentions of hooking up meters or the such, but as I'm sure that you have seen before, just cutting unused wires off or rolling them up in a coil & taping them is just plain ugly! Even though you will not use them at this point in time, you may want to add something in the future, and even if you don't, the way to handle this is to run all wires to your break connector for whatever bundle you are working on and simply let them terminate in that connector. In this case, at the break

connector just inside your coin door, you'd only have the wires leading out the connector side to the coin door that you intended to use, i.e., you'd have no wires out of the plug in positions that were not of interest to you. Dead ended, as it were. Neat, but ready for use at a moments notice.

Continuing with the coin door bundle, add in the service switch line, test switch line, coin 1 line, coin 2 line & the spare line at position "S" that is sometimes used as a "tilt" line. Let's see... thats 5 lines & 6 above, totaling 11 lines! Coin door bundle finished!

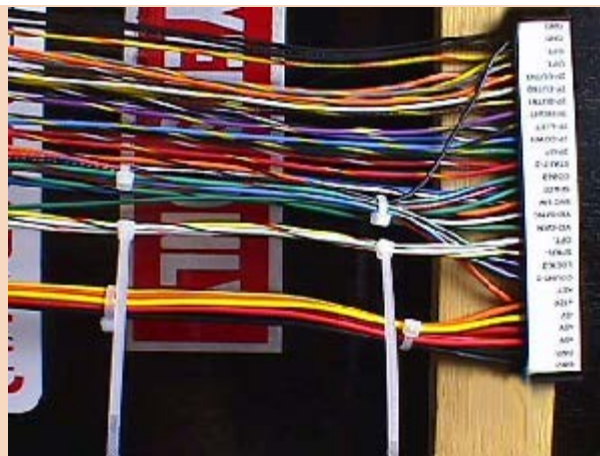


Snip the cable ties & as you can see in the pic below, I put wire markers out at the end of the wires to keep track of them, but you can mark them however you want, or simply cable tie the end.

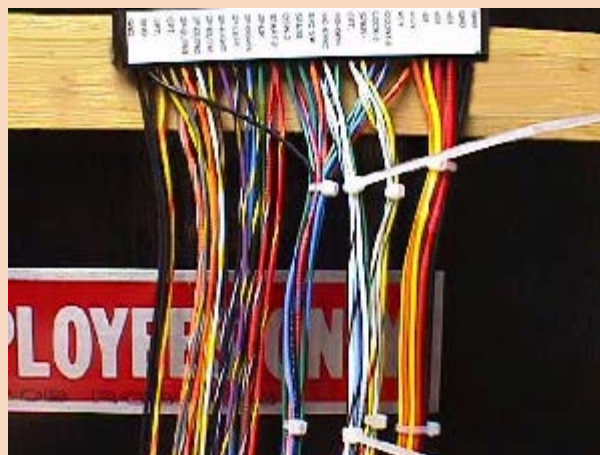


Bundle three... speaker bundle. Moving right along now :-)

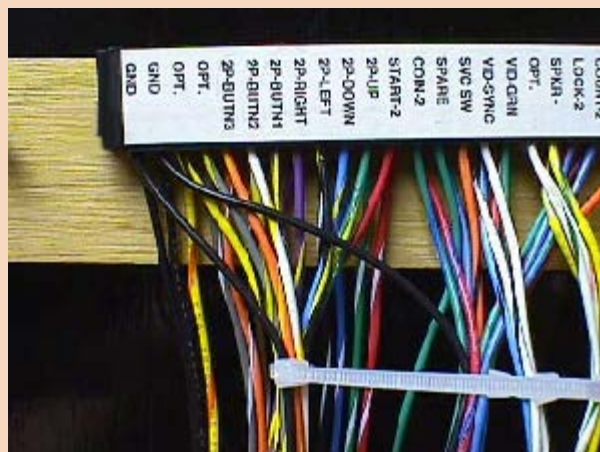
The basic need here is only the 2 speaker lines, but the 2 optional lines next to them are sometimes used for stereo, quadraphonic, floor quaking, ear shattering & over the top sound that rocks your house, so we'll carry them along with the speaker wires making for 4 lines in this audio bundle.



Halfway there! Time for a video bundle, so that we can see pics on the monitor. This is going to be either 5 or 6 lines depending on the harness you are doing. In the case of JAMMA, it is going to be 5 lines... video red, video green, video blue, video ground & composite sync. Bundle these up in the same manner as the previous bundles.

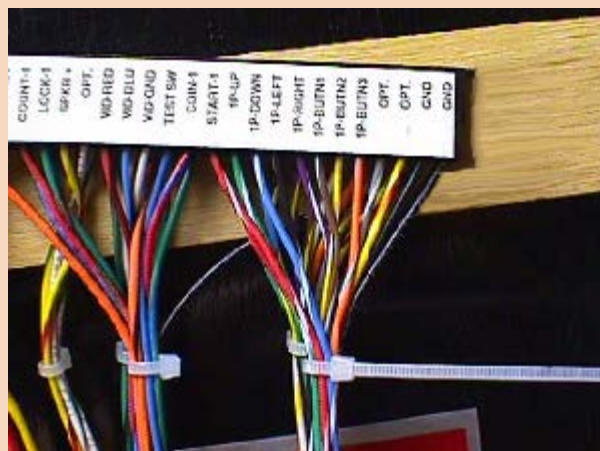


Next is the player bundles & I'll start with player 2 controls so that I end up on the parts side of the connector. You're going to have 11 lines in this bundle...hmmmm.. that sounds familiar. K... we have start, up, down, left, right, & buttons 1 thru 5 along with 1 ground wire to make up this bundle.

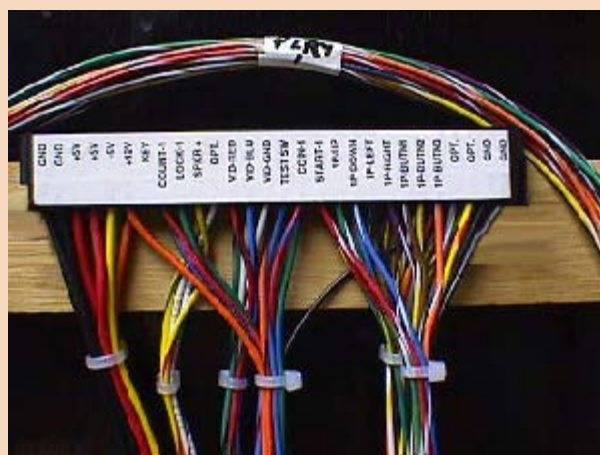


Time to flip it over & do the last bundle... player 1... and it should be the same as player 2, but wait, 4 times 11 lines is 44 lines, plus 5 video, plus 4

audio only totals to 53 lines & we started with 54. Ah... we have one ground line leftover and what better place to run it than in the player 1 bundle for an extra CP ground wire. All accounted for!



In the pic below you can see all 6 bundles and the taped player 1 demo about 6" from the end.



It's time to start hooking some of this up. I've tacked a game PCB up to start with simulating a left wall mount from the rear of a 2 shelf cab. The speaker & video bundles leave together & go up over the top of the PCB. Next is the 1 & 2 player bundles headed toward the cab front. Then the coin door bundle, also headed toward the front on a little lower path.



The bottom bundle is the power bundle headed down for the lower shelf where the PS is mounted. Notice that there is a slack loop in each bundle between the connector & the first cable clamps. This affords plenty of movement when plugging & unplugging the Jamma connector.



The pic above shows the loops better & also shows how to cinch up the bundles at the cable clamps. Often times you see a game that has had a cable clamp that is too tight for the bundle it is holding & has damaged the insulation, maybe to a point where a couple wires are shorting, even, and this can be eliminated by using a cable clamp that is slightly larger. The reason it was not larger in the first place was that they wanted it to keep the wires in place, but you can accomplish the same thing by putting a cable tie on either side of a clamp that it a little oversized allowing more freedom for the bundle.

Below I purposely jumped 2 sizes on the speaker bundle clamp as it headed toward the top of the cab. You can see that even after I cut the cable ties they will be too big to fit through the clamps openings, so they will hold the bundle in place without pinching any wires.



The video line, above foreground, can either hang loosely, as pic'd, with a cable clamp on the top shelf to keep it in place, or you can cable clamp it up & under the shelf to a convenient place to leave a short loop. Remember that you will no doubt be removing the monitor at some time in the future, so you don't want it to be in the way when unplugged.



Okay... I obviously did not cut out a coin door hole in the front for this demo, so I just ran the bundles straight across. They are all labeled in the pic above, as well.



The power supply is facing towards the coin door, but it could face towards the back as well, depending on how & where you want it mounted. I always liked to keep the power bundle in as short of a run as possible... 18" to 24" ... to keep line resistance to a minimum. Your power bundle terminates with spade connectors and does not require a break connector, although many mfrs did place one in line just before the PS. It is a little easier in tight spots to unplug & remove the switcher for replacement or repair, say in a countertop game, for instance, but in a roomy upright it's not all that important.

Break connectors are important to the CP & coin door, so that they may easily be removed if the need arises. There is no standard connector used among Jamma cabs, but if you are doing a Pac cab or other classic game, you would want to use the same connectors & pinouts, so that you could readily swap out CPs or coin doors from other cabs. You can see that 12 position connectors will handle any of the bundles listed here. I like to put a 2 position Amp break connector in the speaker line to facilitate audio problems that may occur somewhere down the road. It sure is easy to just plug up a new speaker to clear or indict your old one when you have a no sound condition. Incidentally, that break connector I put at a convenient spot near the housing, rather than up in the confined speaker compartment.

Okay guys & gals, I've got to take another break here as Alice is due home anytime now and the simulated cab that I've been using is her shelf at the end

of her counter where she keeps her small plastics bins, and frankly, I wouldn't want to be here if she catches me with that getup still mounted there :-) If I'm fast enough, I'll be right back to type in that label to bundle list I promised.



You can see now that cutting out that coin door hole would have landed me in spousal jail :-)

I'm back! Made it & if you don't tell Alice, I won't :-)

Here's another tip. In the very first paragraph I told you that the ends of the wires were stripped, or prepped, ready for use. I've had this asked a couple of times... *If I'm cutting these wires off because they are too long, how does having the ends stripped help me?*

Let's take the coin door bundle to use as an example. It's going to be fairly short in length, so you'll have quite a bit of wire left. 5 feet of wire is plenty long enough to meet any cab requirements. Let's take the coin door bundle out through the opening by about 6", so that you can easily crimp on the sockets for that half of the break connector. Yes... you will have to prep that as each case is going to be cut at different lengths, but when you go to put the pins on the cut off side to finish wiring out the coin door, you already have those prepped ends to crimp on your pins for the other side of the break connector. Now you can easily match them up color for color & slip them into the connector. Route them to their destinations on the coin door, cut them & attach the appropriate connectors to finish it off.

Let's see if I can anticipate any new questions.... well... each line is labeled to their destination, so I guess grounding is the only thing left a little up in the air. You have a ground line coming in with each bundle and in the case of the coin door bundle, you can loop it to every terminal that requires a ground, e.g., you can go to coin switch 1 com, loop up to coin 1 lamp (either side, with 12 volts on the opposing side), then over to coin 2 lamp, down to coin 2 switch com, and if no other grounds are needed, you can close the loop by running back to coin switch 1 com. It'll now take 2 broken wires to kill your coin door ground, but you can omit this last closing lead, if you want. Cp ground is done the same way... Xmas tree light daisy chain style.... at least, the way they use to be.

BUNDLE	PARTS SIDE	SOLDER SIDE	BUNDLE
Power	Gnd	1 A Gnd	Power

Power	Gnd	2	B	Gnd	Power
Power	+5 volts	3	C	+5 volts	Power
Power	+5 volts	4	D	+5 volts	Power
Power	- 5 volts	5	E	-5 volts	Power
Power	+12 volts	6	F	+12 volts	Coin Door
NA	Key	7	H	Key	NA
Coin Door	Count 1	8	J	Count 2	Coin Door
Coin Door	Lock 1	9	K	Lock 2	Coin Door
Audio	Spkr +	10	L	Spkr -	Audio
Audio	Opt.	11	M	Opt.	Audio
Vid-Sync	Vid-red	12	N	Vid-grn	Vid-Sync
Vid-Sync	Vid-blu	13	P	Vid-Sync	Vid-Sync
Vid-Sync	Vid-gnd	14	R	Svc Sw	Coin Door
Coin Door	Test Sw	15	S	Spare	Coin Door
Coin Door	Coin-1	16	T	Coin-2	Coin Door
Player 1	Start 1	17	U	Start 2	Player 2
Player 1	1P UP	18	V	2P Up	Player 2
Player 1	1P Down	19	W	2P Down	Player 2
Player 1	1P Left	20	X	2P Left	Player 2
Player 1	1P Right	21	Y	2P Right	Player 2
Player 1	1P Butn 1	22	Z	2P Butn 1	Player 2
Player 1	1P Butn 2	23	a	2P Butn 2	Player 2
Player 1	1P Butn 3	24	b	2P Butn 3	Player 2
Player 1	Opt.	25	c	Opt.	Player 2
Player 1	Opt.	26	d	Opt.	Player 2
Player 1	Gnd	27	e	Gnd	Coin Door
Player 1	Gnd	28	f	Gnd	Player 2

Happy Gaming.....

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Removing JAMMA Keys

by Bob Roberts

Here's one of those frequently asked questions that deserves a little space in Netland...

How do I remove the key from my edge connector?

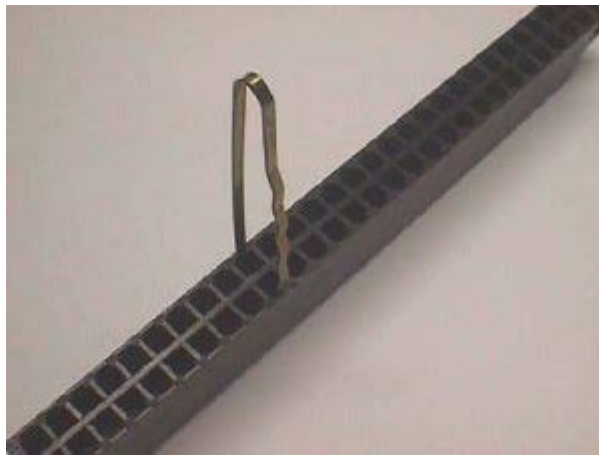
Here's a quick tip for removing those big bad JAMMA keys.



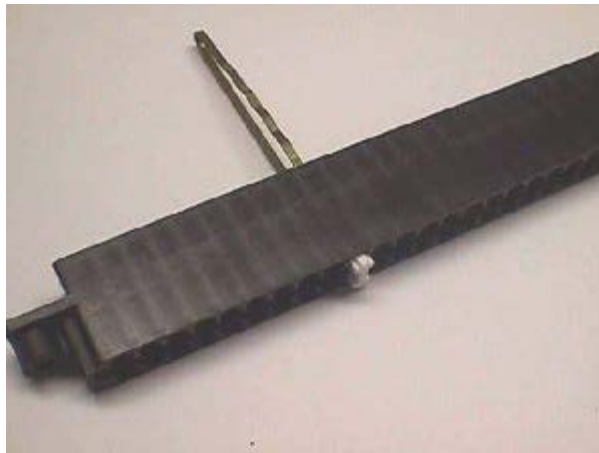
The tool of choice is a simple one... the bobby pin!



They usually have a coating on the tips, so you have to remove that & then open it up slightly larger than the width of your connector.



Pinch the newly formed tines together & insert them into the back of the connector & push.



The key should pop right out.

Happy Gaming...

JAMMA Plus Wiring

by Bob Roberts

Here is another question that comes up several times per week & answers to it and as much more as I can think of pertaining to this topic. Y'all will have to suffer through some more of my attempts at being a computer artist, as I have sold off all my new game cabs/parts & have no CPs to take actual pics of for illustrations. If I do my usual rambling here, it should give pics time to load up for those with slower modem speeds :°O

Starting with the newbie question... What is JAMMA plus? The answer, at least to my mind, is that it is nothing more than a standard JAMMA game that also has additional headers/connectors for other controls outside the spectrum contained in the main JAMMA edge connector. In other words, it is a JAMMA game or PCB that also has other connections (plus) that require wiring into your cab in order for it to work properly.

Driving games, trackball games & fighting games with more than the typical 3 button per player CP switch configuration are good examples of the JAMMA plus. The JAMMA pinout actually has accommodations for up to 5 buttons per player, but very few games took advantage of that and opted for 3 or less direct JAMMA button inputs, and mounted another header on the PCB for these plus connections, usually in a more convenient spot for the PCB designer.

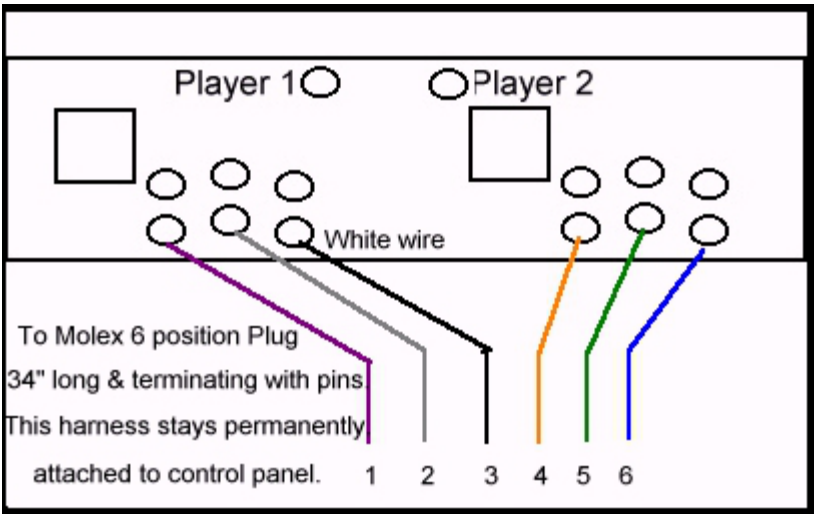
The driving games & trackball games typically had a 4 or more position .100 spaced in-line header. When this type of unique game specific CP was needed on a universal cab on location, the whole control panel usually went along with the PCB to be changed....sometimes even a wider or deeper CP drawer was used to accommodate such things as having to roll the trackball directly at the monitor glass, giving the player enough room to keep from putting a fist through the glass...and any plus connectors were directly wired to that specific control panel. On the many games that only called for extra buttons for kicks, punches & other various functions, only the PCB & a method to add these input switches from the PCB to the existing CP was necessary. Everyone adopted their own way of accomplishing this, and some manufacturers really came up with some losers...IMHO...requiring free hanging double-sided .100 headers of numerous amounts of positions, and twice as many wires as needed, making the whole system a bird's nest of wiring & an electrical nightmare that even their own techs couldn't keep straight.

The most common plus harness needed was to control inputs 4, 5 & 6 on the player 1 side of the control panel & the same on the player 2 side. This is only 6 inputs total & a simple feat to add in, but many ops just kept a plus harness right with the PCB that included the ground loops, and whenever they would make a change of games, they would pull the .187 QDs off from the CP switches, more often than not, pulling the wires off & leaving behind the QD still attached to the switch, and many times ending up with ground faults.

The way that I handled this in new games, conversions & multiple game cabs was to first make my own color code for the plus 6 wires, so that they would be universal throughout all the games that passed through the shop. I'll put the whole thing here with dimensions & my colors, but if you intend to make up some of these plus harnesses yourself, you can modify any of it to suit your own needs.

JAMMA Plus Colors	
Player 1 Switch 4	Violet or your color
Player 1 Switch 5	Gray
Player 1 Switch 6	White
Player 2 Switch 4	Orange
Player 2 Switch 5	Green
Player 2 Switch 6	Blue

Above are the color codes I've always used and their designated switches on the control panel. Using these colors, I'd cut the first 6 wires 34 inches long...this fit most everything I came across...and crimped on the QDs, cable tied the bundle & added them onto the CP normally open terminals of player 1 switch 4 thru P2S6 as in this great artistry below.



Now it's time to cut the next 6 wires & they are 14 inches in length and will terminate as required by the specific game you wish to control, e.g., Street Fighter II CE would terminate with a .100 Molex 10 position housing at positions 3/4/5 & 7/8/9 of header CNI 02 on the board. This short 14" harness would stay with the PCB at all times, ready to plug up to the plus buttons of any previously wired as above CP.

Since we don't want to just twist the ends of these wires together to complete their circuits, I guess it is time we added a Molex .093 6 position plug with pins to the ends of the wires coming from the CP, and to add it's mating Molex .093 receptacle with sockets to the PCB side as pic'd below. Remember now, you want every CP you do to have the Molex plug, and every PCB to have the Molex receptacle. This way they are all interchangeable. The connectors are with their respective components, so that when you change out to a different PCB in your cab, you simply plug the 2 together & the JAMMA edge connector for a completely wired game. Just a minute of your time & no cussing at broken or pulled out wires.



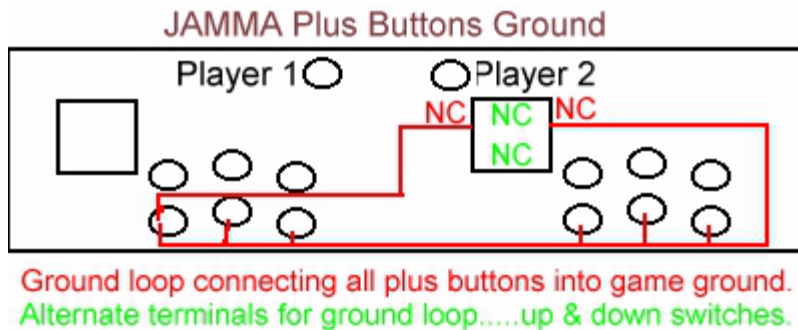
JAMMA Plus Colors to Molex Pos #		
Player 1 Switch 4	Violet or your color	1
Player 1 Switch 5	Gray	2
Player 1 Switch 6	White	3
Player 2 Switch 4	Orange	4
Player 2 Switch 5	Green	5
Player 2 Switch 6	Blue	6

Hmmmm...we now have 6 buttons added to the CP & no way to toggle them to ground. Of course, we could just splice into the ground loop already on the control panel, but there is an easier & neater way to do this. First, let me address the key word above that is often overlooked....that key word being **loop**. When wiring up a control panel's ground circuit, rather than running 2 to 4 wires up to the CP for grounding, it is better to run one...you can have a spare ready to go if you want...and make a continuous & closed loop of it. Done this way, you can cut any one of the ground jumpers and still have a fully functioning ground circuit. Saved many a service call over the years.

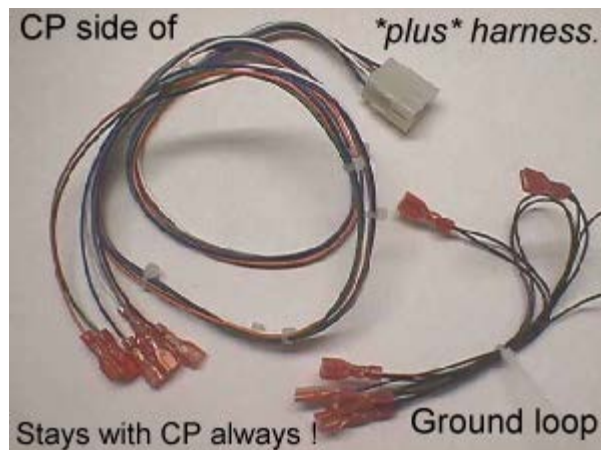
Okay... back to the grounding of the plus buttons/switches. You need to cut four 6 inch black wires & 3 12" black wires, get out your QDs and start by putting one on 1 of your 12" wires. Now chain in 2 of the 6" wires... another 12" wire & then two 6" wires, ending up with the final 12" wire, also terminated with a QD. You should have a straight chain when finished that goes like this:

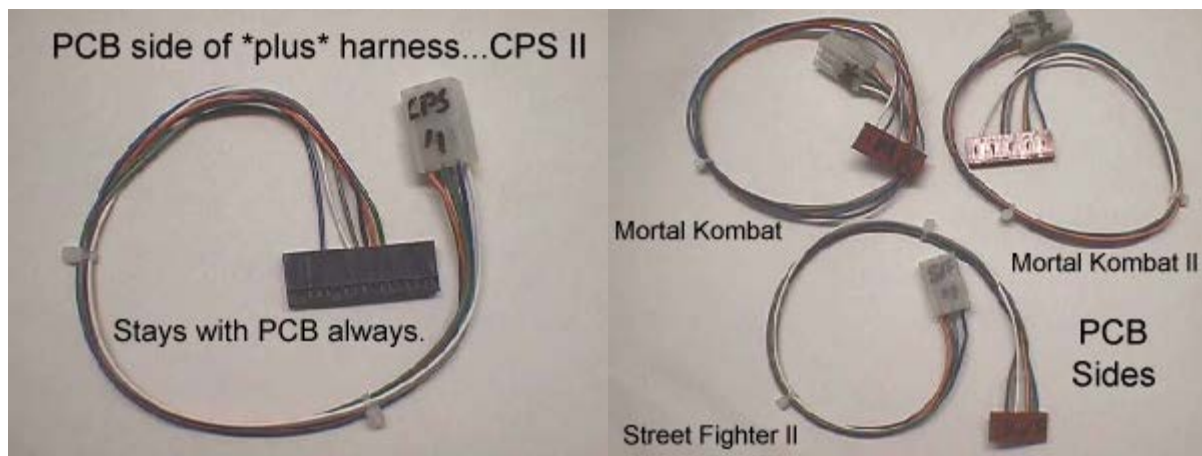
QD-12-QD-6-QD-6-QD-12-QD-6-QD-6-QD-12-QD
 JS---COM--COM--COM---COM--COM--COM---JS
 LF----SW4---SW5---SW6----SW4--SW5--SW6---RT

To daisy chain the ground loop into the circuit you take one end & plug it to the 2nd player joystick left NC (normally closed) and loop over to P2S6 com, to P2S5 com, to P2S4 com, to P1S6 com, to P1S5 com, to P1S4 com & finally back to joystick 2 right NC. You now have a normally closed ground loop circuit that will always be grounded from one end or the other since you cannot open both left & right switches at the same time. The same will hold true if you use up & down NC switches.



Although I don't have pics of the CPs, I do have pics of the harnesses as sold on the Parts Page, and I can put them up here for **my pic is worth a thousand words** illustration. As you can see from the pics below, this will save you money if you only have a Mortal Kombat & a spare MK II PCB that you swap out in the same cab....now for the collector who has five or more different *plus* PCBs that are utilized in the same cab, a big savings is seen, since after the main harness is installed, each game PCB only needs the short side...cheaper to build, or cheaper to buy at \$7.50. For that matter, buying the 2 piece harness at \$15 is less than the sometimes \$25 for a game specific plus harness from the manufacturer.





Much easier to understand this concept with pics, huh? I could have typed in another thousand words, but I'll spare you :)

Here's a few common layout maps:

[Mortal Kombat](#) [Street Fighter](#) [Street Fighter II](#)

This is a little off from this old guy's forte, but I'll give it a stab... A couple of people have asked about these plus harnesses as it pertains to using a PC to run lots of games in a single cab. Obviously, these would be 180° out from what would be needed for that purpose, but their goals seem to be the same....keep the game cab intact to revert back to OEM with no hacks such as cutting off the PCB plus connector & soldering the wires directly back to the PC keyboard I/O, so the above concept should aid in that endeavor, also. You can (A) replace the game plus harness to one of this type & then get a PCB side open ended for connecting to the keyboard I/O...1 plug & you are back to OEM, or (B) cut the existing OEM harness in this same manner, installing a Molex connector in line and then make up your own PCB side Molex with the other end connecting up to your keyboard I/O. CP switches then toggle either the OEM PCB, or if plugged to the PC, the representative keystroke.

As always, all these parts can be found on the [Parts Page](#).

Happy Gaming.....

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Joystick Notes

By Bob Roberts

About every 12 to 15 months I'll have a newbie email & say that the switch terminals were bent on his joystick (or buttons) when he received it. Sticks are factory prepacked and they have had bent terminals on them since their inception. Over the years they have had various packaging from the cardboard boxes that Wico use to ship in to the plastic bags used today by most mfrs, and they've always had a terminal or two bent during shipping. In every case, it has been recommended not to straighten any of these until in the hands of the end user. This was more obvious to people on the old leaf switches, since they could readily see that bending them back and forth could cause them to snap off rendering them useless. Microswitches look to be a little tougher, but they too, will break off with bending them back & forth, hence the need to leave them as is till their final resting place.

Here's one that comes in a little more frequently... my new stick catches sometimes & doesn't have a very smooth action to it. Sometimes doesn't engage a certain microswitch or hangs up on one. This is caused by placing the nylon pivot cylinder (usually referred to as a spacer) on the bottom of the shaft under the actuator* instead of slipping it onto the shaft before inserting it into the body.

* What to heck is the actuator is another Q. The actuator is the nylon piece, sometimes round, sometimes square, that goes on the bottom of the shaft and does the actual engaging of the microswitch as you push the shaft.

Will the Ultimate 4-way actuator work on my 8-way Ultimate? The 4-way has a different body than the 8-way and in reality should not work, although some people have reported that they got it to work when adding a washer.

Which joystick is the best one? Everyone has their own opinion on this and I guess that is why there are so many to choose from. Price was said to have an effect on which ones sold the most, as the Ultimate has always outsold all others combined, but after selling them all at an equal price for the past month the Ultimate did not lose ground, but the normally less expensive Competition gained on the Super closing the huge gap that it has enjoyed for many years. The once dead Competition seems to owe its resurgence almost entirely to the MAME scene.

Another problem sometimes encountered when sticks are not responding correctly, or some have said it's just too low, or too high, from my control panel is caused by improper assembly, sometimes only because they are spaced for a wood control panel & are on a metal control panel or vice versa. When installing on a metal control panel you need to use the shorter of the two spacers (pivot cylinders) remembering to put it on the shaft before inserting it to the mounted body & on the bottom of the shaft, after putting the actuator on you need to push it up on the shaft to expose the upper groove for the e-clip.

When mounting on a wood control panel you'll need to use the longer spacer, helping to raise the stick up from the control panel and after putting the actuator on you would use the lowest groove on the shaft for the e-clip.

Trying to figure out how to make the stick 4-way or 8-way... well... with all sticks the larger diameter actuator, whether it be separate ones or a flip over type, will be for 8-way operation & the smaller diameter one for 4-way operation.

Here's a recent report on Happ Pac replacement joysticks of popping & not operating smoothly. This was free hanging & not mounted... evidently Happ tossed them together "hap"hazardly knowing that you have to disassemble them for mounting, anyway. In this case the upper black actuator was installed upside down. Here's a pic of correct positioning:



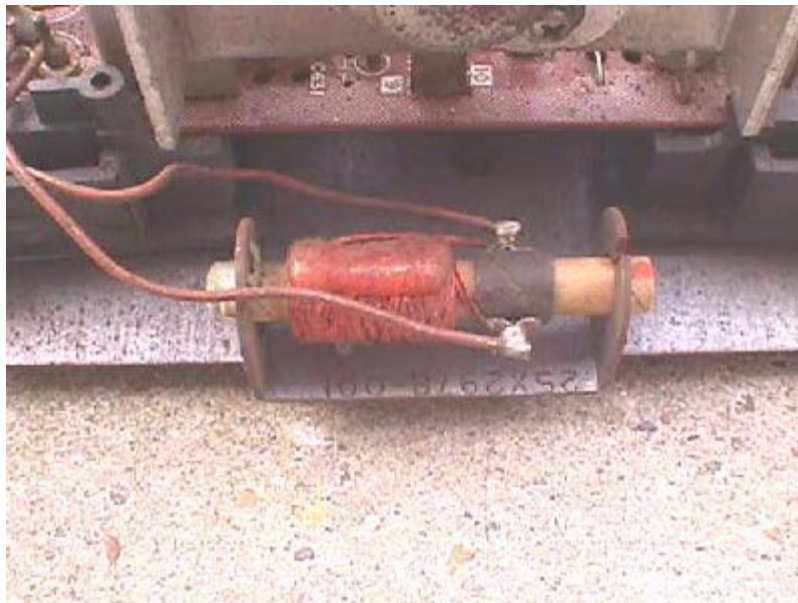
K4600 Width Coil Transplantation

By Bob Roberts

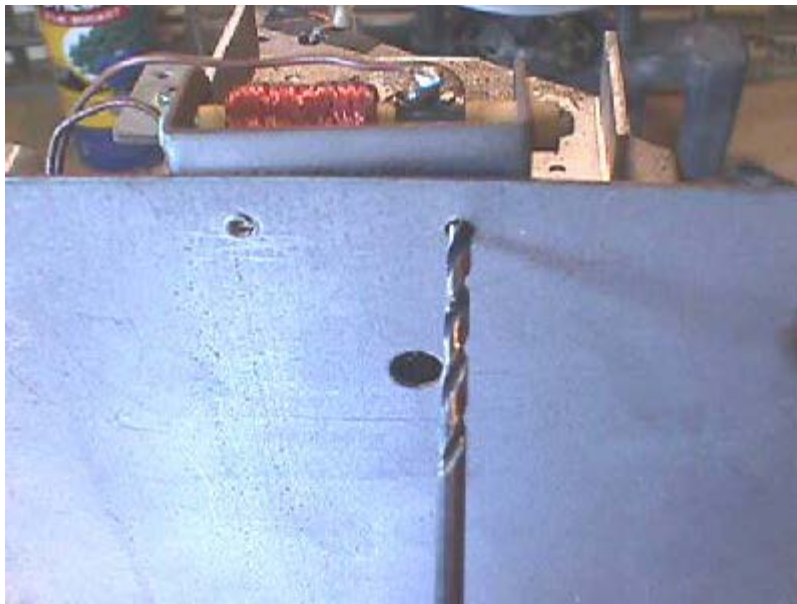
Finally! I've literally had this on my desk for 10 years now & although I am midstream on 2 other projects currently, a certain party needs help with this at this time. Being that he is probably the thousandth person to ask over the years & I've always planned to have done it right after each inquiry, I decided to just do it now before another 10 years passes. I'm talking about all those broken Wells-Gardner K4600 width coils :-)

As many of you have found out the hard way, the K4600 coils are nearly impossible to transplant. I don't know how many times I've heard/read this one... I found a good K4600 width coil & I tried to pinch the little metal tabs in to release it, so that I could put it in my pristine K4600 monitor with the busted up width coil only to have it fall apart before I could get it out :-(The reason these coils do not take well to removal is because of their continuous service over the past 28 years that has made their cardboard sleeves weak & brittle. A successful removal would probably run 1 in 10, but there is a way to safely retrieve them for many more useful years of service.

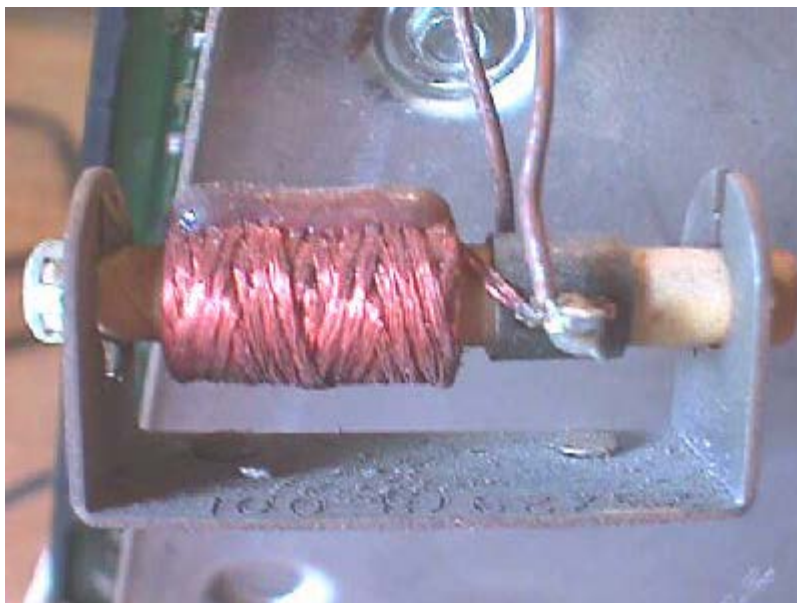
Let's start with that old clunker that you spotted in your local ops warehouse junk pile with a perfectly good width coil mounted on it.



You haggle it from him for whatever coin you have to spare & take it home & check the ferrite core to be sure it is free turning... most are... with your plastic width coil adjuster. It passes & you're ready for surgery. Since you know that the sleeve is brittle & cannot be tampered with, your only solution is to transplant it cradle & all... like in the nursery rhyme :-)
) Look at the bottom of the chassis pan & you'll see that the cradle is outrigged via 2 rivets.



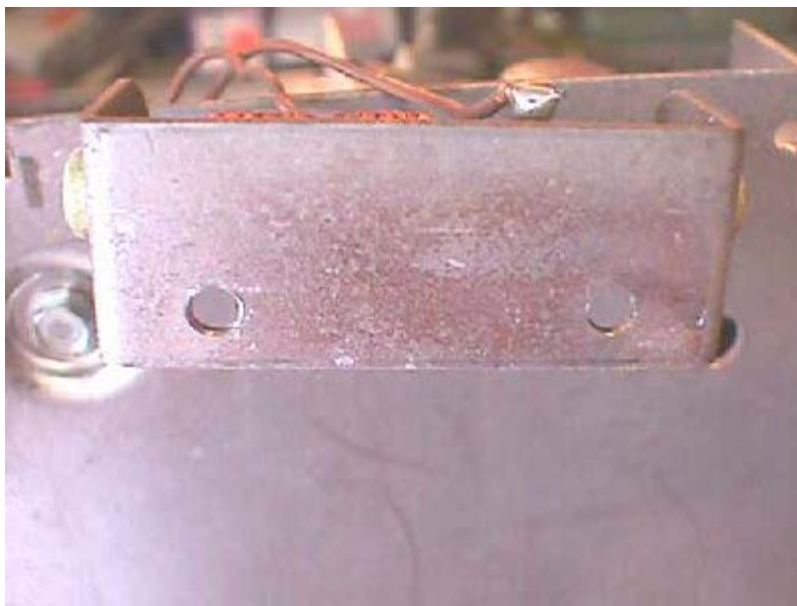
Secure the chassis by whatever means you have at your disposal and use at least a 3/16" drill bit to drill the rivet tails off. It is important that you do not use a smaller size bit as you may end up drilling through enough to release the rivet & allow the bit to penetrate the very sleeve you are trying to salvage.



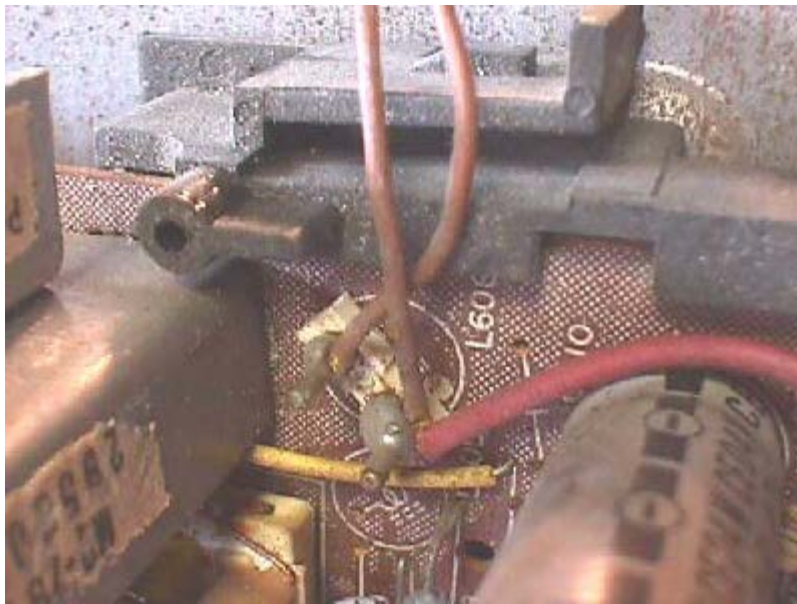
A successful removal of the cradle will look like the pic above with the rivet heads still intact. The mounting holes are mostly hidden by the body of the coil, so you really do not want to attempt to get physical in trying to remove the heads. Simply deburring the rest of the rivet tail will allow the heads to roll... as it were :-)



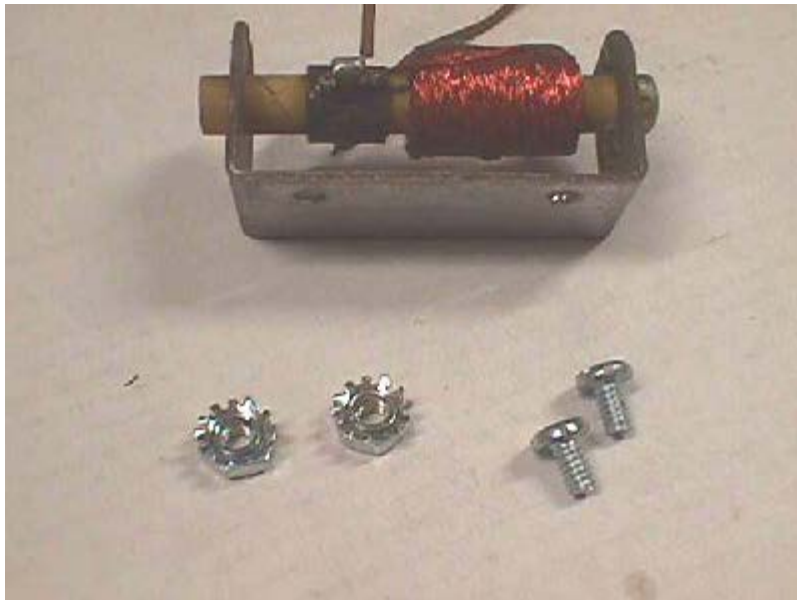
We have so many flushcutters at our disposal that I use them for everything from snipping coat hangers to pulling teeth, but you may want to use a pair of diagonal cutters, side cutters or even a pair of needle nose pliers to debur the rivet tails.



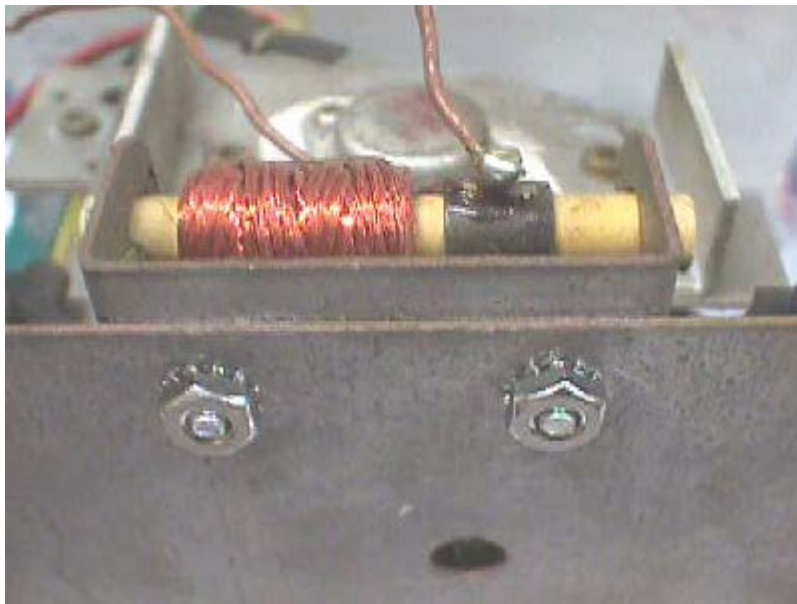
She's free! Well... almost. The wires were left intact as a safety net... should the coil & cradle accidentally fall it would have a short trip that would not cause damage to it.



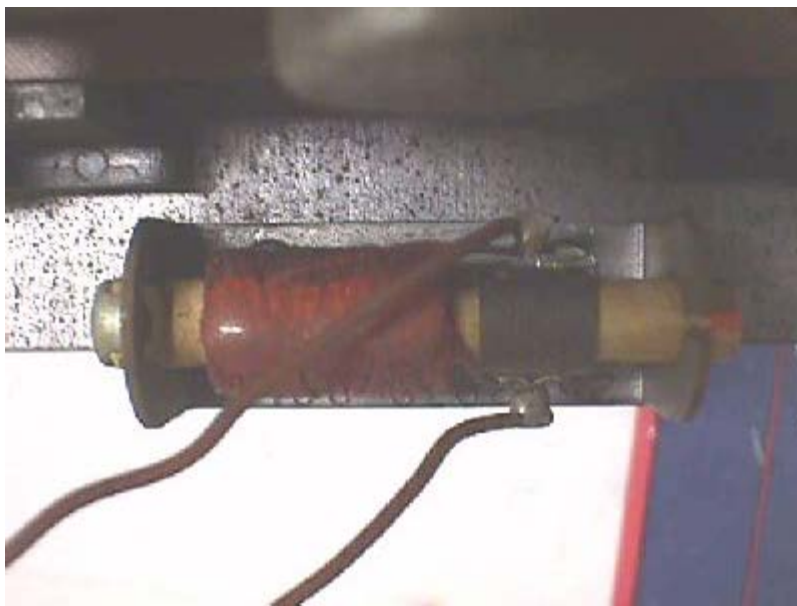
Now the wires can be cut freeing it up entirely. You can unsolder them if you like, but just a quick snip will work just fine.



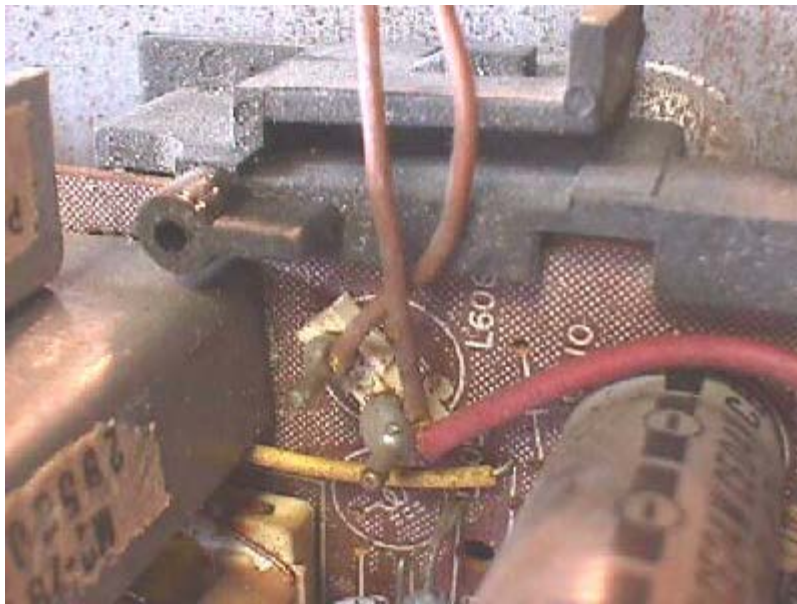
A couple of 6-32 x 1/4" machine screws & a couple of 6-32 keps nuts will reattach the cradle/coil combo to your transplant recipient. As I have said, there is very little room between the sleeve & the cradle making a hard job of placing the screws in the holes when you have big paws like me, so here's a little tip you might try... I use regular household scissors to cradle... not another cradle :-)... the screw head & slide it over the hole & let her drop in.



Here's why you need to use keps nuts... there is no room to use a screwdriver on the screw heads for tightening them. The keps nuts will bite in & allow tightening from the bottom rather than the top.



You can see from the pic above that a screwdriver is just out of the question. Okay... all that is left to do is to reattach the wires.



There are many different ways to reattach the wires to keep this 100% detachable for any future needs. You can add in a couple bullet connectors (single housings) or a 2 position plug & receptacle, but the best way I found was to crimp on a couple .062 sockets & add a tad of solder to stiffen them up. They simply plug directly to the posts that they were soldered to originally.

Hopefully, this will be of help in saving the lives of a few width coils.

Happy Gaming...

PostScript: Yes... I do have just a few of these salvaged coil/cradle combos at \$10 each with mounting bolts.

[Help Page Index](#) Big Bear's Bulletin Board [Site Index](#)

K6100 C100 & C101 2 LEAD REPLACEMENTS

Longest Lead

+

Shortest Lead

-

C101

Shortest Lead

-

+

Longest Lead

C100

K7000 Series Cap Kits

What happened to the K7000 series standard cap kit? Well... someone noticed all those unused numbers in between & decided to use them, so it's no longer a K7000 cap kit, i.e., K7xxx to cover them all. Basically, the first 2 numbers now dictate the cap kit to use. I'll put a quick reference chart here to guide you to the correct kit.

Chassis Model	Use This Kit
K70xx	K7000
K71xx	K7000
K72xx	K7200
K73xx	K7300
K74xx	K7400
K75xx	K7500
K76xx	K7000
K78xx	K7000
K79xx	K7000

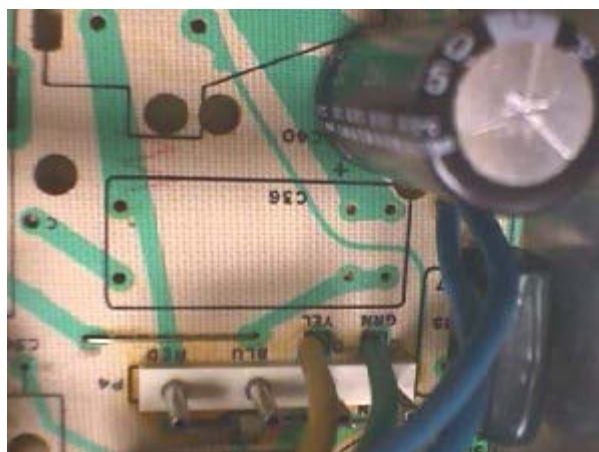
Changing K7000's C36 Retrace Cap

By Bob Roberts

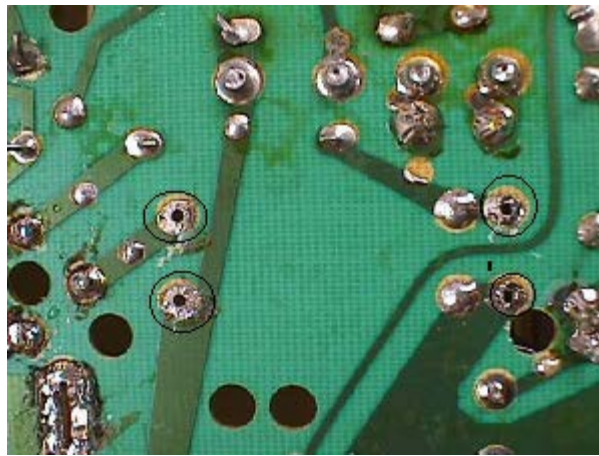
I'm asked about the C36 capacitor at least twice a week & it invariably is in regards to replacing a shorted one... one that has 4 legs, is green or blue, and has the words "Crit Safety Cap" imprinted on it - the name that has stuck over the years. It is actually used for retrace, but I guess you could call it a critical safety cap if you were to replace it incorrectly... leaving the HOT's collector free floating.



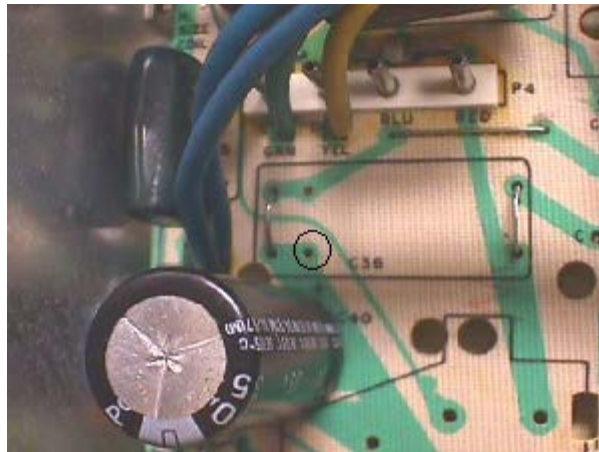
These are found in early versions of the K7000, later versions replaced these with standard two legged radials, but PCB traces were also modified to accommodate. You'll have to do your own modifying to replace these with the common type, as the old chassis depended on this cap to complete the HOT's path to ground & flyback winding.



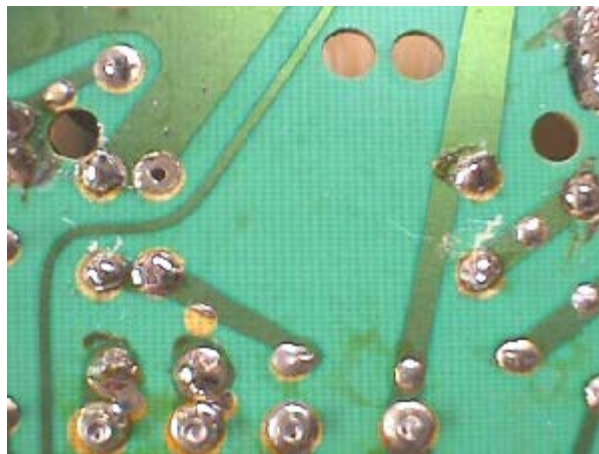
The two legs on each end of the old capacitor should measure a dead short to each other as they are electrically the same point & as you can see in the outlined block above for C36 (upside down), the two end legs are actually needed to complete the circuit on the PCB.



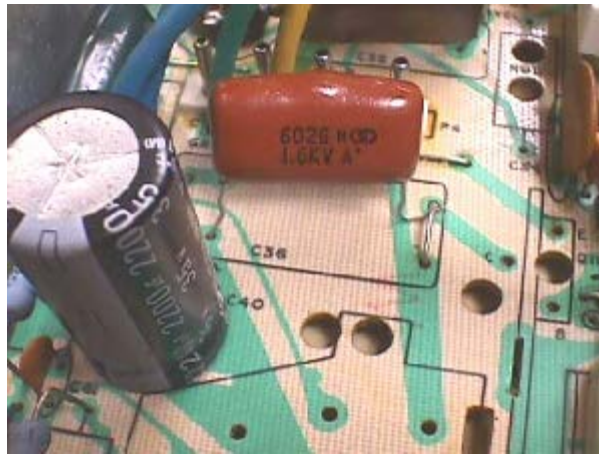
Above is the solder side of the board after removing the cap. The first thing to do would be to connect the circuits back together. As I've said in other docs on the Help Page, I always saved the clippings from cap replacement, resistors & other components to use for jumpers in situations like this. Easy & cheap :-)



Rather than square the ends of the jumper to 90°, I prefer to leave them arched & this case is a good example of why I do that. It leaves a nice tie point, whether it be for a scope lead clip while you are working on the chassis or for mods like this one.



After soldering in the jumpers you need to remove the solder in one of the two parallel dead (unused) thru-holes next to the jumper on the left above. Flip the chassis over and make a hook with one lead of your replacement cap. Hook it up under the jumper closest to the HOT & guide the other end through the hole you opened up & solder this end in from the underside.



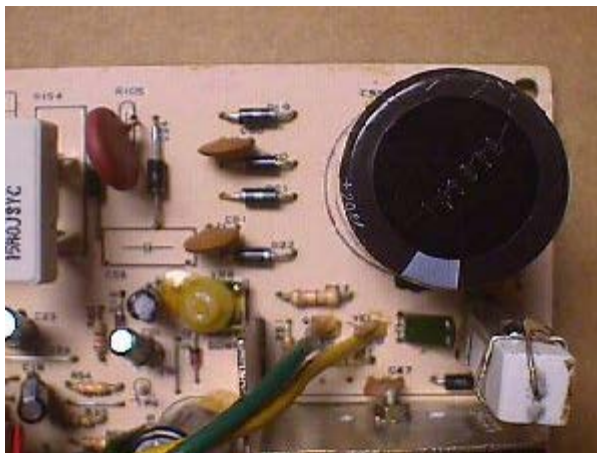
Now you can finish the hook end by closing the hook around the jumper, aligning it to suit your taste & then soldering it to the jumper. Once cooled... ball the joint with solder to hide any pointy place that may lend itself to arcing. If you've missed balling in the Help Pages elsewhere, it is just melting/melding a round ball of solder onto the finished joint to encase it.

Happy Gaming....

Dead K7000 Chassis

By Bob Roberts

I've noticed something more & more here lately that appears to be sort of putting the horse before the cart. It appears that many are ordering a flyback repair kit from the get go when their K7000 chassis is dead. The power supply should be checked first as it is very common to have voltage surges short one of the bridge rectifiers, especially during springtime thunderstorms.



The first step should be to ohm out the diodes that comprise the bridge above... D19, D20, D21 & D22. If any one of them is shorted it can be replaced with a 1N4007. You'll need to check R103, a 2.7 ohm 7 watt resistor, as it will likely be open, as well.



R103 is the large resistor above that is mounted vertically in a metal stand. If it is open & needs to be replaced you'll need an exact 2.7 ohm 7 watt replacement. Many of you ask for one with a metal cage around it, but all you need is the resistor itself, which you can change out on the metal stand.

Another component in the B+ power supply above is the filter C55... a 560uf200v cap. A frequently asked question pertaining to the B+ filter is does it come in a typical cap kit. The simple answer is no. The main reason that B+ filters are not included in any sort of cap kits on the market is that it would make them cost prohibitive for a shotgun type repair. These filters are usually still good & they really ham it up when bad with unmistakable symptoms such as the postage stamp pic, violent weaving of the pic or the proverbial black bar rolling thru the pic.

Happy Gaming....

K7000 Neck Board Pots

By Bob Roberts

Here's another problem that keeps reoccurring regularly over the years... broken pots on the K7000 neck board. These discontinued pots had a reverse footprint to common pots still on the market today, so even when you find a vertical mount one with a seemingly matching footprint & go to install it you get the bad news.... the knob is facing inward toward the CRT neck!



How do you save the neck board? Well... here is my way: Remove the cardboard shield & replace the pot/s that you need with horizontal mount "E" type pots right on the solder side. Then you can drill holes in the shield corresponding to the pot/s allowing them to poke out the back. If you're replacing all then you can adjust everything carefully until you are satisfied & then put the shield back on with a couple cable ties without making any holes. It's not very often that one of these needs to be readjusted after the initial setup, but should the need arise it is simply a matter of clipping one of the cable ties to expose the pots.

This one used the following pots from the [Pot Page](#) :

3 x P1090 - 200 Ohms

3 x P1092 - 2K Ohms

Happy Gaming....

The Real Bob Roberts™

Konami Sub Harness Pinout & Colors For 3 Players & 4 Players

CN3 - 3 Player Controls		
1	Coin 3	Violet/Stripe
2	Empty	N/A
3	3 Player Left	Red/Stripe
4	3 Player Right	Yellow/Stripe
5	3 Player Up	White/Stripe
6	3 Player Down	Blue/Stripe
7	3 Player Push 1	Brown/Stripe
8	3 Player Push 2	Orange/Stripe
9	3 Player Push 3	Green/Stripe
10	Empty	N/A
11	Empty	N/A
12	Empty	N/A
13	Empty	N/A
14	Coin 3 Ground	Black
15	CP Ground	Black

CN4 - 4 Player Controls		
1	Coin 4	Violet
2	Empty	N/A
3	4 Player Left	Red
4	4 Player Right	Yellow
5	4 Player Up	Black / Stripe
6	4 Player Down	Blue
7	4 Player Push 1	Brown
8	4 Player Push 2	Orange
9	4 Player Push 3	Green
10	Empty	N/A
11	Empty	N/A
12	Empty	N/A
13	Empty	N/A
14	Coin 4 Ground	Black
15	CP Ground	Black



Although I have been making these Konami 3 & 4 player straight through harnesses for anyone who needed them over the years, they have not been listed on site, but so many are asking about them now that I decided to add them to the Parts Page along with details that I use, so that do-it-yourselfers will have a guide.

Before I forget, let me mention that many Data East bds & other import boards used this same pinout for 3 & 4 player hookups.

To keep expenses down on them I do not install a break plug to enable them to be used with other types of 3 & 4 player games, but I will put a guide here for anyone who wishes to do so. The cheaper connector to use is the Amp connector of 12 or 15 positions, but it is unforgiving if you make a mistake, without the the expensive extraction tool (\$50), so maybe the Molex would suit your needs better.

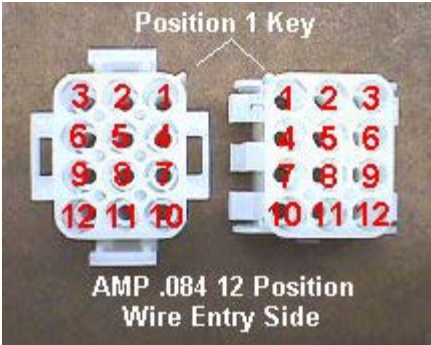
Let me stray here for a moment & give you a quick tip to help you out of trouble if you should err with a pin/soc to a connector & do not have any extraction tools. If you have a spare socket of the same type, you can crimp & solder it onto a piece of solid copper wire from ordinary household wire, a large straightened paper clip, a piece of coat hanger or other similar material to use as a handle. Then widen the opening of the socket to allow it to slip over a misplaced pin or socket in your connector & this will depress the dogs/tabs to allow removal.

K... installing a break plug in an extra player harness is done much the same as with a JAMMA ["kicks" harness](#) and since the Konami only utilizes 7 wires to the control panel you'll need a connector that will interrupt at least 12 positions allowing for other wiring such as a start button & more than 2 I/O pushbuttons.

Also, note that with the Konami using separate coin switches you'll need to put a 1 or 2 position break connector in the coin lines. You'll need to use a 2 position if you decide to carry both the coin I/O & the ground wire from the PCB's player header or you can use a one position for the coin I/O only & jumper grounds from your coin door ground used for the 1 & 2 player coin switches. Of course, there is the option of running the coin lines up to your CP through that connector along with your other wiring for use with simple pushbuttons if you do not require coins for play.

If you use 15 position connectors for each player you can assign the same

positions as found on the .100 connectors as shown above, i.e., position 3 would be left, position 8 would be push 2 and any unused could be assigned to any task you wanted. I'll assign a random set up below using a 12 position connector for reference sake & you can use it or make up your own guide to use for all the 3 & 4 player games you'll be adding to your cab.



Player Control Assignment		
1	Left	Yellow
2	Right	Red
3	Up	Blue
4	Down	Green
5	Start	Gray
6	Push 1	Orange
7	Push 2	Violet
8	Push 3	White
9	Empty	N/A
10	Empty	N/A
11	Empty	N/A
12	Ground	Black

The easiest way for a novice to enter a break plug is to choose where you want it located for easy access when changing your game bd & simply cut one wire at a time & insert it into the position you assigned for it. Essentially, all you are doing is interrupting your I/O lines so that you can redirect them to the proper location on a different game bd. Your CP side will always stay connected on the control panel, but may be hanging at the break plug unused if you had a 2 player game bd installed that did not need it.

Of course, for the creative player wanting to utilize the dormant controls while using a 2 player game, you can tap into your matching JAMMA I/O lines with a mating break plug connector so that player 3 controls become a duplicate of player 1 controls, while player 4 controls become a duplicate of player 2 controls. One reason that you may want a setup like that is so that playing a 2 player game with a friend allows you to use opposite sides of control panel giving each plenty of elbow room for those special maneuvers.

With the installation of a different 4 player bd you simply make up your PCB side to the correlating header on that bd, and then terminate into the position assigned on your CP break plug. For example, on the Konami PCB connector

position 6 is "down" & goes to position 4 of my 12 position break plug assignment directing it to "down" on the CP. If you were to make up a PCB side for NBA Jam, "down" would be found on the PCB header at position 8 which you would run to position 4 of my 12 position break plug directing the line to "down" on the CP.

In the case of NBA Jam above, if you started with only the Konami CP harness installed, you would need to run the "start" line & the pushbutton 3 line on the CP side of your break plug, as well.

Each bd that you intend to use the 3 & 4 player controls with would have it's own PCB side that stays with the bd and is ready to plug up to the break plug directing your wires to the proper controls on the CP.

The basic Konami 3 & 4 player harness is on the Site Index under ["Building Supplies"](#). The connectors can be found on the [Connector Page](#).

Happy Gaming...

- Lamp Socket Tip -

Coin door lamps & lamp sockets have been the source of many Qs over the past 8 years, and although I have addressed quite a few of them on my Help Page, this particular tip has not been covered & I think it's about time it was, so I'm jumping it to the top of the to-do-list.

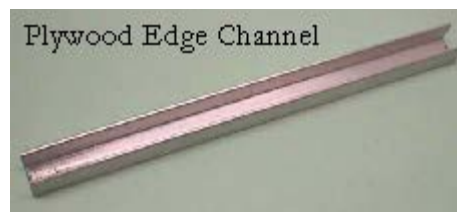


These are two of the common types of lamp sockets used on the coin doors. The older type on the left was a constant source of problems after many years in the field because of the sockets loosening up enough for the terminals to spin. They were slightly better than the ones used on the old WMs coin doors, but nevertheless, a problem. Ops used to bend them all out of shape when replacing the lamps & I'm sure that didn't help in any way.

Then later on when they saw that the newer type, as pic'd on the right, was holding up much better, they would remove the old sockets & bend the tab straight back to slide on one of the newer sockets, as pic'd below.



The trouble with this was that the bending of the tab weakened it so much that they often times broke clean off :-(I located some small "L" brackets meant for shelving at a local lumber store (pre-Home D) that worked out perfect when fastened in place of the old bayonet socket. You could just slip the newer wedge socket right onto it aligning perfectly. As is the case with so many good things, they simply disappeared from the store's inventory and said to be no longer available. The store chain is no longer now :-(



|ramble| Sometime back in the day, I had read an article in one of the industry mags about using aluminum plywood channel over the piston rod of the pneumatic jukebox door lifters to prevent them from closing while your head was still inside them :-(Since my trusty short cue stick had once failed me, causing me to see many new stars that I hadn't seen before, I was keenly interested in this channel & ran out & purchased some to give it a try. I cut off a piece for a Rowe

jukebox, opened the box, inserted the channel and it worked like a champ! I ended up stocking every size I could find & had cut pieces to the correct length for various brands & styles of jukeboxes, labeling them as I went. I found many uses for this channel around the shop & in makeshifting parts that were hard to come by. This channel worked out well for this lamp socket mount, as well. |/ramble|



I never used a pattern for this, just cut them out as I needed them, but I'll put the basics here. First, I would drill a hole in the channel front about $\frac{3}{16}$ " from the end, centered, with a small step drill. I believe the first step is $\frac{1}{8}$ " if you're using a std drill bit. After the hole is drilled & any burrs polished away I would just slip the piece into the vise & cut off a piece of channel approximately $\frac{7}{16}$ " to $\frac{3}{8}$ "... always did it by eye & never had a problem, but you may want to get an exact measurement if you plan to try this.



I never bothered to cut off the upper unused portion, but I suppose you could take it a step further & remove it if you wanted to. If you don't have the original screw it can be fastened with a $\frac{1}{4}$ "x440 bolt & nut as pic'd above. The channel comes in various sizes to slip over the cut edges of plywood shelves... $\frac{1}{4}$ "... $\frac{3}{8}$ "... $\frac{1}{2}$ "... $\frac{3}{4}$ "... and the size used for this app is the $\frac{3}{8}$ ". The channel can be found at Home Depot with some searching... seems no one that works there ever knows where, or what, this stuff is & it appears to be in a different location in every store :-(

I see that lots of you have trouble with the types of lamps & sockets, along with the voltage that is used to power them, so I'll insert a brief comment here on this subject. First the bayonet type is a lamp with a smooth cylinder base that has two projecting pins which fit into slots on the holder & when twisted a quarter turn, lock themselves into the socket. Bayonet lamps would be #44 or #47 when used in a 5 to 6VDC or 6.3VAC circuit, and when powered by 12 volts you'd need a lamp such as the #1813. The wedge type is as implied, a wedge lamp is pushed straight into the socket & has a chisel-shaped base, as opposed to, the cylindrical bayonet type. One loop of exposed wire to either side of the wedge base makes contact in the socket. Wedge lamps used in a 5 to 6VDC or 6.3VAC circuit would be #555 & in a 12 volt circuit you'd need #161 lamps.

As for voltage needed in your particular cab, even if there are no lamps in it & you have no manual or schematics, you can always measure the voltage right across the two wires that feed the lamp... right at the socket. If you own a game you should have a meter, but on the off chance that you don't, any meter should do the trick, even a small pocket-sized \$5 analog meter from your local electronics store.

Long Buttons - Metal Panel

by Bob Roberts

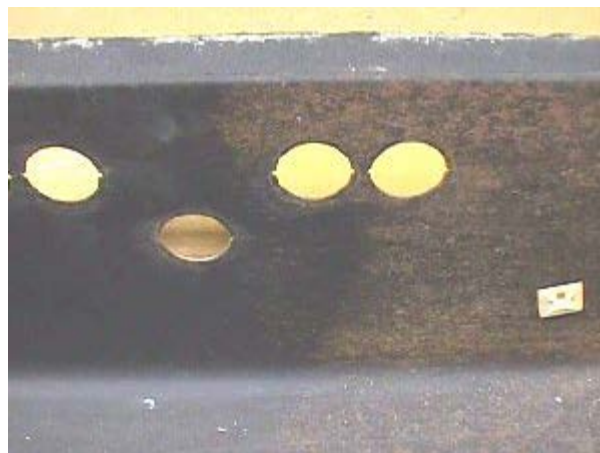
Here's something that I threw together at three o'clock in the morning to help Patrik from across the big pond & I thought it might help others, as well, so I'll post it here... such as it is.

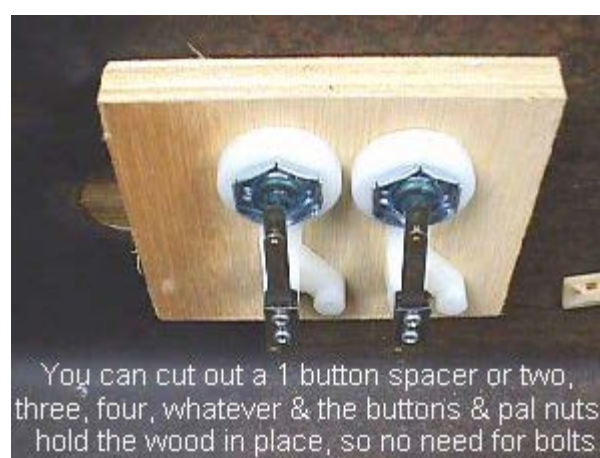
The topic was using long leaf buttons on a metal control panel. The new leaf switch holders are made for wood panels & by adding 2 of the new nylon spacers they can be used for metal control panels with short buttons. To obtain the correct spacing for a long button on a metal panel, you'd need to add 2 more spacers for a total of 4 spacers. If you have the original switch holders that were a 1/4" thicker then you'd only need 2 spacers. In any event, the gist of this conversation was spacing & how I thought the old school way might be better when it comes to using 4 spacers... especially now that the mfrs think that nylon is gold when it comes to pricing them... by simply backing the buttons with the proper thickness of wood.

Many times in the past I have backed whole middle sections of metal control panels, although not for spacing & a little on the expensive side since all buttons had to be replaced at the same time. These were on classics with metal panels where the ops would complain of them being bent all out of proportion by rough players using the joystick to drag the game around or by trying to force the character back on screen by banging on the joy :-() The bolts of the joystick & the pal nuts on the buttons will hold the piece of plywood in place & fortify the panel while being completely unintrusive... you can remove it at any time without any signs of it ever being there... no added bolt holes to be plugged or unsightly clamps, glue & etc.

The same thing applies to just buttons that you want spaced properly. You can find a piece of scrap wood that meets your requirements & drill out 1 1/8" holes... 1,2,3 whatever you need... and then just cut off the number of holes needed or back several at one time, essentially, wherever you need the spacing because you may have a button on one side of the CP & the another to the far opposite side making 2 spacers more prudent. Of course, if you plan to back a group of say.. 3 buttons with one piece of wood.. you will have to layout the pattern to match the holes in your metal panel & be careful not to make the excess wood so that it interferes with anything else or you'll end up doing a lot of trimming.

K... here's the example I threw together at 3AM much to the chagrin of my elderly neighbor... nearly 20 years my senior who opened his back door & said, "Mr Bob, do you know what time it is?". I replied, "Sorry, I don't, but I'll be glad to run into the house & find out for you." :-) What's a little table saw noise between neighbors anyway :-) The drill was fairly silent in comparison!





Happy Gaming...

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Leaf Switch & Button Solutions

by Bob Roberts

As usual, I'm extremely short on time, so I'm going to throw up a start of this button solutions page...meaning to get back to it & elaborating it to it's fullest potential, but good intentions & time sometimes do not meet, so in the meantime, these are picture solutions that I have been emailing to interested parties and hopefully, they will reach a lot more newbies up here & maybe a few collectors who were left out in the cold on this one.



Williams wood...pressed wood...type control panels shown above & hopefully the type on pics will show up clearly enough to read. Also, note that there are leaf switch holders already cut down to serve this function, but they too, are not always around when you need them.

[New Leaf Holder/Switch For Wood CP - \\$4.50](#)

Below is one of the metal control panel leaf switch button solutions.



[New Leaf Holder/Switch/Spacers For Metal CP - \\$5.50](#)

3/22/00...see, I am adding to this page :)

I get asked almost daily about the Nintendo buttons. While these are not leaf type buttons per se, they do use a button similar in style, if not in size, to activate an adjustable microswitch under the CP.

I have a CP construction page on my agenda, but thought that I would address this issue here on this page since it will

be some time before I get a chance to complete the CP page.

On to the Nintendo solution I used and probably most shops nationwide, I would surmise. The holes for the Nintendo buttons were 1/16th inch in diameter smaller than the industry standard of 1 1/8" in diameter, so the typical leaf or micro buttons would not fit through them. Many an op tried to force them into fitting, only to end up cracking the plastic overlay. Since I was already using 1 1/8" [conical bits](#) (now AKA step drills) for drilling all holes in control panels, I simply used it to enlarge the holes to accept the larger & more commonly available buttons.

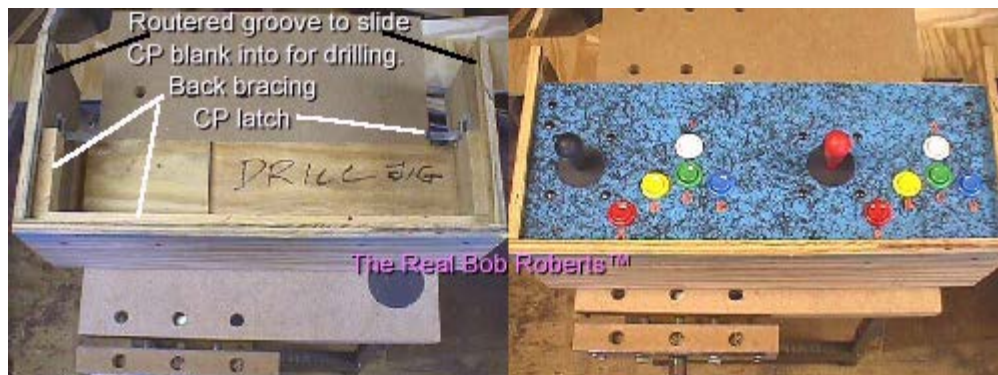
In the pic below, I have a CP on the jig in the carpentry shop to enlarge the holes, but this can be done readily on the game.



To do this on the game, you need to lift your CP, remove the buttons that you are going to replace, take a newspaper and open up several layers to form a catchall for the debris placing it in the opening between the front of the game & the monitor. Now, making sure that any hanging wires fall out of harms way, set the CP back in it's mounting position. Enlarge the holes with the conical bit, or if this is not practical for you, you can use a round file & carefully work your way around the entire circumference to evenly enlarge the holes.

Once the holes are all large enough for your test button to drop through, you can gently raise the CP up from it's mounting position, and then carefully remove the catchall newspaper container & toss it. This catchall method comes in extremely handy when adding a button hole to a metal control panel, since you surely do not want any metal filings getting lodged into your pc board or power supply.

Here's a temp pic that will be moved to the CP page in the future, but for right now, it may as well be up here where someone may get some use from it.



Happy Gaming.....

Leg Leveler Installation

by Bob Roberts

Most game manufacturers used T-nuts stapled to the bottom of the cabinet to screw the leg levelers into & as we all know this did not fair well for games that were often transported from location to location. The leg levelers got hung up on tail gates, dollies, curbs.. anything that got in their way... and often times would pull the T-nut completely off the cab. Sometimes just sliding a game into position would bend the leveler enough to rip them off entirely.

When these injured cabs came through the shop we always mounted new heavy duty leg leveler plates & it's all we used on our new cabs, as well. Looking at pieces of what once were cabinets post Katrina the one thing that really stood out was that the leg leveler plates were still intact, even when the bottom was separating from the rest of the cab, proving that these most likely will last a lifetime.

I've explained mounting the leg levelers & plates to newbies so many times over the past 14 years... doubling over the recent craze of building your own cab to house the multi-game bds... that I figured I best note it here to point future builders to.



K... you got all these parts & now what to do with them. I made a simple cab bottom corner cutout & I'll run through this for one mounting & leave you to your imagination for the other three :-)

The very first step if you're doing a replacement is to make sure there is no wiring or components such as transformers, power supplies or filters in the area of the 4 mounting plates on the inside of the cab. The last thing you want to do is drill blindly and pull a fistful of wiring out of the hole when you pull the drill bit out :-(



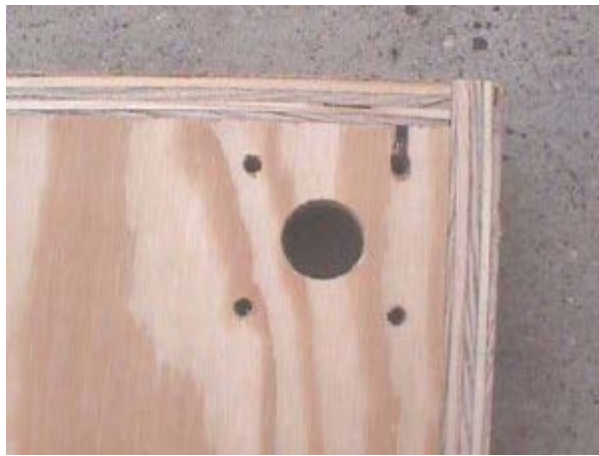
Step 2... Line up your plate one inch from each cabinet edge and use it as a template to mark your drill spots.



Step 3... Just taking a second look inside to be sure nothing gets drilled! :-)



Step 4... Use a quarter inch drill bit to drill the 4 outside holes.



Step 5... Use whatever you used to drill out your 1 1/8" CP button holes to drill the center hole. This is something you should already have onhand making it an easier job & it makes for a roomy hiding spot for the welded nut, as well as, a neat & smooth finish job on the underside where you have to stick your hands for final adjustments.



Step 6... Fasten the plate with the 4 carriage bolts, washers & kep nuts. Using kep nuts eliminates the need for a lock washer & binds the slotless carriage bolts in a tight cinch.



Step 7... Ready to install the leg leveler making sure to leave the nut on it.



Step 8... Install all four leg levelers to approximately the same distance for a good starting point.



Step 9... After your cab is in it's final resting place you can level it by adjusting each leveler & once you're happy with it you tighten the nuts to the mounting plate securing each leveler in place for eternity... or until the next time you move it.

If you want a complete kit for your cab you can just ask for Bob's Leveling Kit (\$18.00) to save shopping the individual items on the [Parts Page](#).

Happy Gaming...

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Midway Cocktail Hum Bars

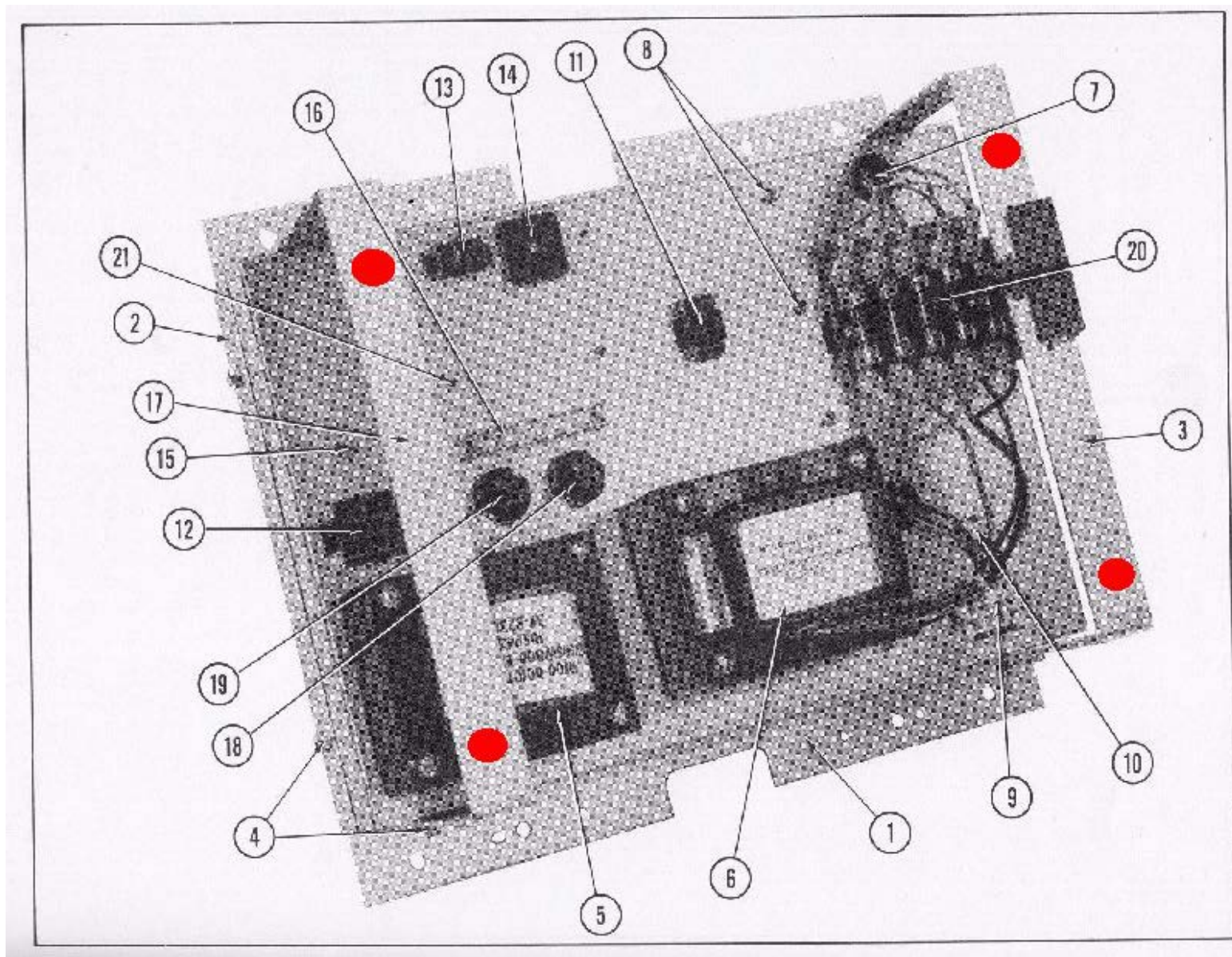
by Bob Roberts

Here's a Q that I have answered a k-thousand times over the past 12 years here & 27 years overall & it still keeps coming back so often that I am amazed that it is not something known worldwide yet. I have two people awaiting this answer currently, so I'm going to just throw up this quick note even though I am in the middle of another page that is probably more important.

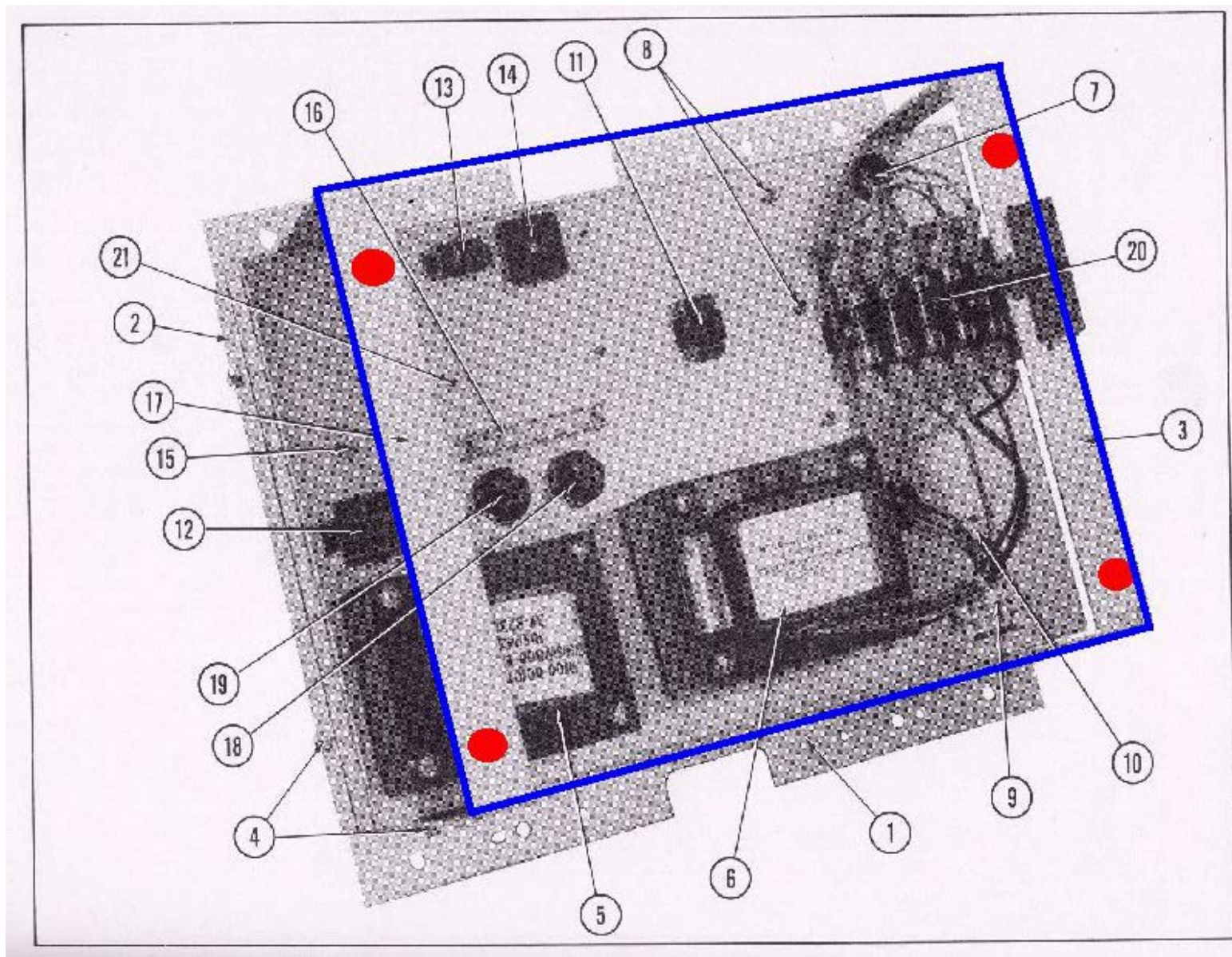
- **Various Forms of the Q:**

I have a Super Pac CT, Ms Pac CT, Tron CT or other Midway CT that has a terrible hum bar in it... weaves, rolls, is squiggly, insert your opinion of the symptom... and I cannot find the reason for it. I have noticed that when the cab is open the hum bar goes away, but as soon as I close the cab it is there big time!

What all these Midway CTs have in common is the power chassis in the bottom of the cab known as the "suitcase". Here's a rough pic of it below:



The cause of your problem is induced by the close proximity of the monitor to the "suitcase". If you see what people refer to as the "handles"... red dots on them in the pic... then it is definitely your problem. The red dots are located where there are pre-drilled holes in the "handles" and they are used to fasten a sheet metal cover that will shield the induction between the monitor & "suitcase".



You need to add a flat metal shield as outlined in blue above. A good sheet metal shield can usually be found at your local sheet metal shop as scrap most times & if they need to cut it with a brake they might charge you a buck to do it... at least that is what I found locally... and after I bought a brake I use to swing by several local sheet metal shops for what they call scraps free for the taking, but I always found some pretty nice sized pieces. I've been told that roofers are another good source of shielding material.

Hummmm....bye-bye :-)

Happy Gaming....

MCR Replacement Ribbon Cables



This is one of those things that has been haunting me ever since I said I'd get them made for y'all. I'm going to do my best to cover everything that has come up with these things.

As far as I know, these were suggested by Clay Cowgill, at least that was the name that popped up most often in emails. I guess quite a few were attempting to make these things without much success & wanted to know if I could do them or get them ordered in for the Parts Page. I kept saying that I didn't have the time to do anything with them, but as the list of needy people got longer & longer, I caved & sent out RFQs to several companies. I went with the lowest bid on these, but price is the first thing that draws the emails.

I know that y'all are emailing about price with good intentions & I thought it would subside, but here we are years later & every newbie that is in some way connected to PCs, sends the email that starts off with you're paying too much for your SCSI cables... you can get them at XYZ for \$1 each. Well... yes, I know I can get them under \$1 each, but MCR cables cannot exceed 4 inches without added filtering to the lines & these cables are a minimum of 18 inches long! Here are quotes from places that y'all have sent me to because of their inexpensive cables... all well under \$2 for 18" cables, at least at the time of these quotes.

- AtoZ Cable, Inc. - 250 pieces your price would be \$5.50 each plus shipping
- Digi-Key - We can make the needed cables in-house at \$6.00 apiece with a minimum of 100 or \$5.35 apiece in lots of 500-1000. Let us know if we may assist you with this.
- Rogers Cable - Those cables could be made available to you for \$5.75 each in lots of 300 or more. Please advise quantity needed.
- Atlas Wire & Cable - The very best we could do would be \$5 each in lots of 500. In larger quantities we may arrange something for shipping.

So... you see, smaller is not always cheaper!

Next is the email stating that there are 2 rows of pins, unlike the originals, and that there are 25 positions in each row instead of 24. Well... when I started with these I didn't think that I needed to go into the mechanics of them

as everyone seemed to know how to use them & I remember at the time someone had sent me a link to another Help Page whereby they had doc'd this. I'm guessing this Page is long gone by now & since there are so many new people entering this hobby, I'll try to put a simplified synopsis here.



There are obviously two rows of pins in each connector. You can use either row, but you must use like rows... the 2 upper rows or the 2 lower rows. The 2 upper rows are actually all the odd numbered positions when the connector is used for it's designed purpose and the red stripe on the cable marks the number 1 position as shown in the pic above by the white blocks. It's less confusing if you use this number 1 pin to mate up to your first pin on each header of your MCR PCB and let the last position (49) hang out over the end of the header.

Remember... if even one of the five interconnect cables goes from upper on one end to lower on the other, it is the same as not having a cable at all & the game bd will not work. By the same token, if your extra position is on opposite ends it will not work! The extra position hanging over the end has to be hanging over the same end on each connector, so that the end wire of the ribbon goes into space on both ends.

Essentially, each cable is it's own 100% plus backup, since you not only have the 2 rows to utilize, you could also use the spare line with either row giving you a little bit more of an edge in case you should somehow damage the outside wire of the ribbon.

Another thing that was brought up by James Hagen recently was that the connectors fit tightly up against one side of the PCB when used on Tapper or Timber due to the extra position. I don't have any of the boards here to look at, but I'm guessing this is due to a limited notch space in the PCB. If this is the case, there is almost always an ample distance between the edge of the PCB and any traces or thru holes, so the offending edge can be sanded or filed a tad to make room. Some people are real proficient with Dremels & can burnish down the edge in short order, but I don't recommend that you try this even if you are skilled, because it only takes one slip to ruin a PCB. A piece of sandpaper on a block of wood that fits the opening will easily do the job. You can also use a file, but in both cases, you want to be sure that the solder side of the PCB is fully secured... perhaps on a sheet of cardboard with only the edge you are working on hanging over your bench... and that no residue gets on the parts side of the PCB. Residue from the PCB, eraser residue, if you use one to clean the pins/edge pads on a PCB, should always be kept

away from the parts side of a PCB because the particles can work there way into a socket causing a line to be intermittent or totally open. This enlarging is something that was very often necessary on bootleg PCBs & when changing edge connectors as some had ears that were too wide to fit inside the notched out PCB edge fingers. Chopping off the edges of the connector would be an eyesore, whereas shaving a tad off the PCB enlarging the notches was not noticeable at all.

[MCR Cables On The Parts Page](#)

As any new questions arise on these interconnect sets I will be sure to address them here.

Happy Gaming...

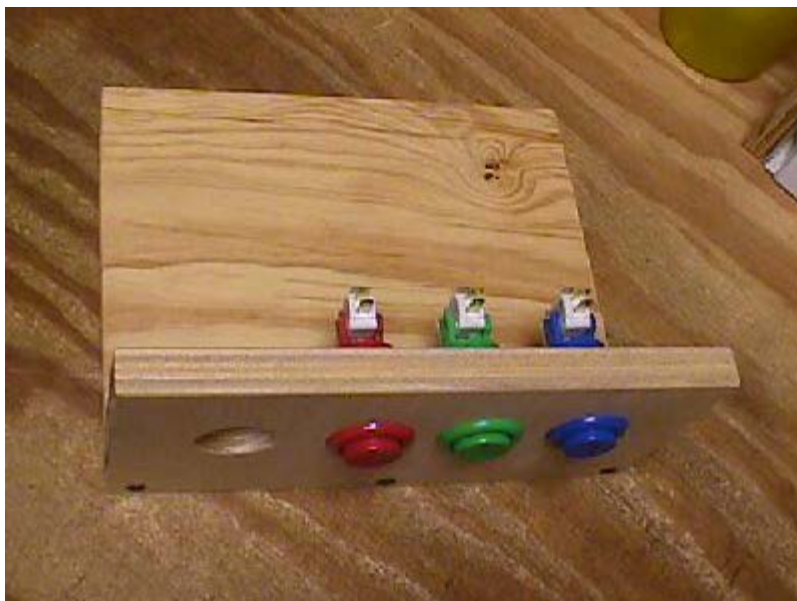
RGB Hunter

by Bob Roberts

A question that still comes in email at least once a week without fail is, "How can I tell whether my missing color is a monitor problem or a game board problem?" I covered one way to do this back in 2001 by using RGB extension cables & another working vid game's output or monitor to get the answer, but it seems that the droves of newbies have only their first game & no way to do that. There is another way to bias the monitor's RGB guns to obtain the answer. I'm going to super size a model to work from & then you can use your imagination to come up with something that works for you. I'll expound on some other possibilities after the basics.



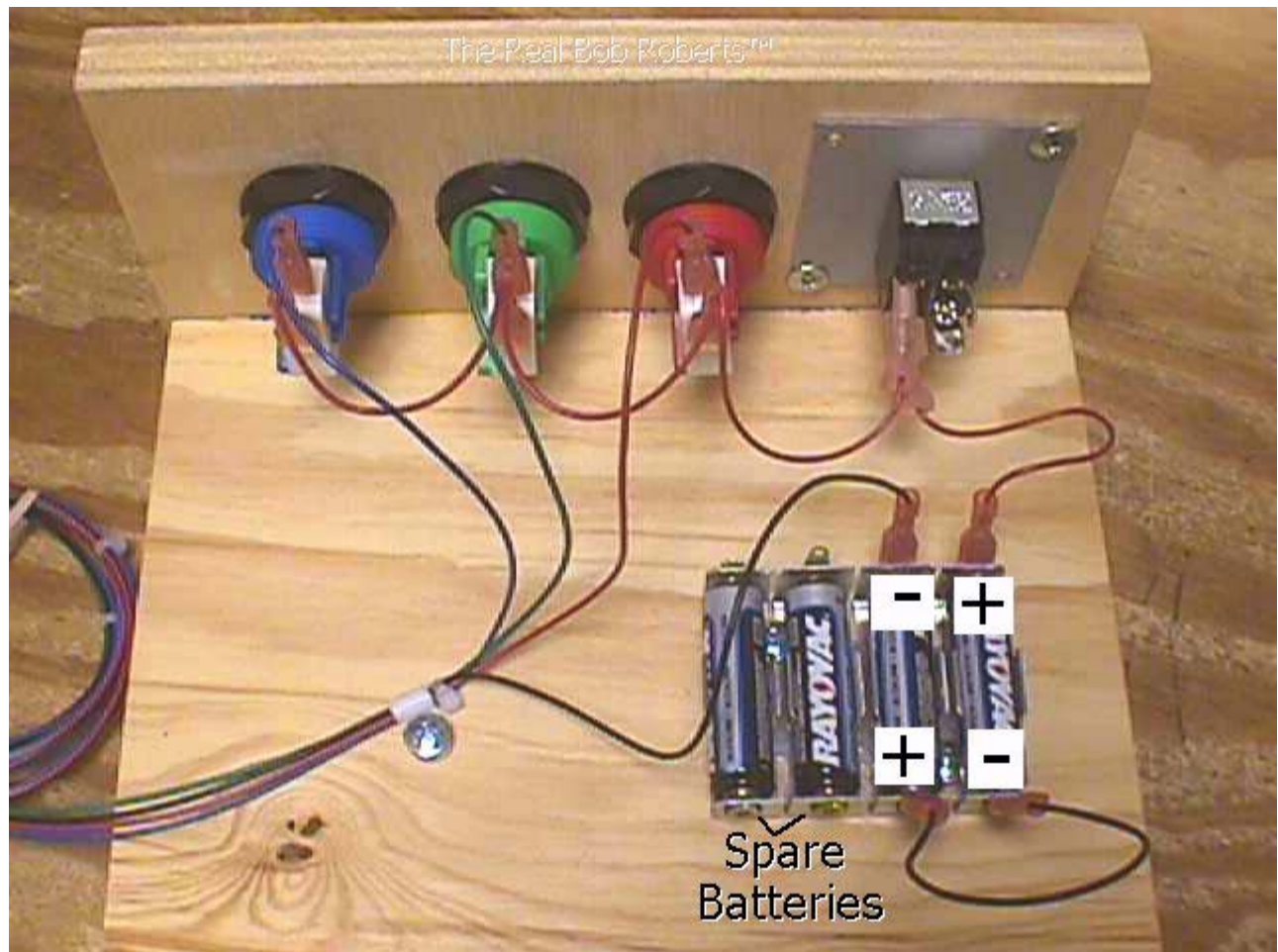
A couple pieces of scrap plywood will allow me to make this large & open for viewing. I've drilled it for a standard size on/off switch & three microswitch pushbuttons.



One advantage to using microswitch pushbuttons is that I can color code them.... R-G-B.



This is the basic needs.. three pushbuttons, an on/off switch, a battery holder & a video cable.



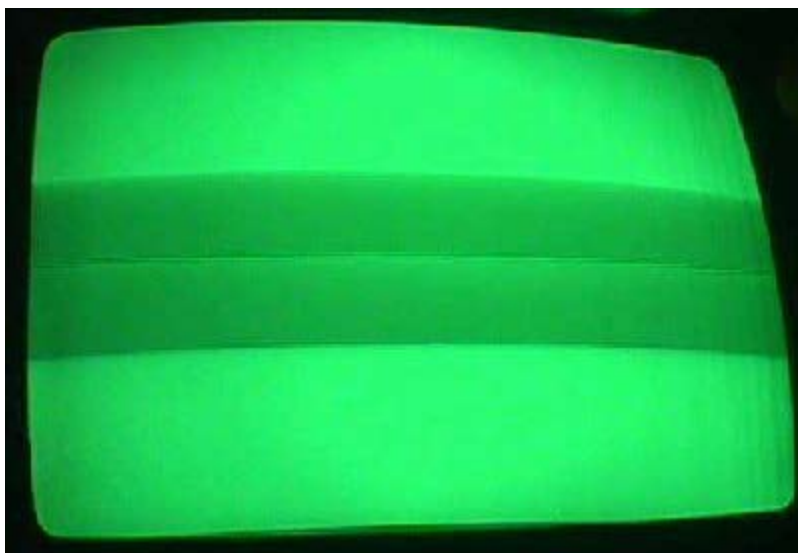
Wiring is simple. Each video wire from the harness goes to it's corresponding button color.. red to red, green to green & blue to blue. The black ground wire goes to the negative battery terminal. The positive battery terminal connects to the on/off switch. From the on/off switch each button is looped in via the common terminals.

Ready to use in no time at all & can be made from old scrap materials... an affordable tester.

With your game off you simply unplug the video connector & plug your tester to the header. Turn the power back on & power on the tester.



Pushing the red button will produce a red raster.



Pushing the green button will produce a green raster.



Pushing the blue button will produce a blue raster.

The camera picks up the hum bar, but it is not seen by the naked eye. If you get each color to come on as you push the button then your problem is not the monitor, but rather the game board, wiring from it to the monitor or perhaps any connectors in the line. If one of the colors does not come on then you know you have a monitor problem & better yet, you know what circuit it is in. Since you have three identical circuits this is an easy fix for a hobbyist without really having a knowledge of electronics. The easiest way would be with the power off & using an ohmmeter & simply comparing measurements between the bad culprit & either one of the good circuits. As soon as you find the component that doesn't measure the same as the good one you've found your problem. Should you not find anything different in your missing color circuit you may have a bad gun in the CRT & it would be time to find someone with a CRT tester/rejuvenator.

Okay... some other ideas on building this cheap tester. First off you can build it in any size project box. You can shrink the whole thing down to a pocket tester by using mini-switches & a connector for the video harness. You can add an LED power on indicator. You can substitute the momentary switches to toggle switches or even on-off-mom so that you can combine on's to help you learn what color is missing by eye.

Happy Gaming...

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Whats My Monitor ??

[WG K4600](#) [WG K4900](#) [WG K7000](#) [WG K7000](#)
[Electrohome GO7](#) [20EZ](#) [TM202G](#) [SI 319](#)
[GO5-801](#) [GO5-802](#) [WG 19V2000](#) [Compare XYs](#)
[KTA - 915](#) [Wei-ya 826HR](#) [Eygo](#) [GO7 CCO & FCO](#)
[WG K6100](#) [WG U2000](#) [Korean AM-0316](#)
[Korean AP-0621](#) [Toei TC-V820](#) [KGR-1901](#) [Eago \(old style\)](#)
[Sharp XM-2001N](#) [Disco DMC-2090DT](#) [Nintendo Difference](#)
[MTC 900E](#) [MTC 9000](#) [Kagi](#) [Toei 20"](#) [Sanyo 14"](#)
[Toei CM-F20U](#) [Unknown 1](#) [Unknown 2](#) [G07-CAO](#) [WG U5000](#)
[Matsushita 14"](#) [Sega MC-2000-S](#) [WG K4500](#) [WG V1000](#)
[T & E](#) [Kortek](#) [Promax 1000](#) [WG K3000](#)
[WG K7200](#) [SI 325](#) [Hitachi K14C](#) [M5000](#)
[Toei CM-A20](#) [Hantarex Polo](#) [WG K8000](#) [Pentranic](#)
[WG K7400 Series](#) [KJ-1915](#) [WG K7300](#) [Kortek KT-2502LF](#)
[Wei-ya 825H](#) [Nanao MS8-26SU](#) [Mackvision 3M25](#) [WG D9500](#)
[Sharp Image](#) [K7203](#) [SI-727R-DS](#) [SI-629 DSR](#) [TEC TM-623](#)
[KT-2914F](#) [Toei CM-A14](#) [Kortec KTX-26](#) [Sanwa PM1723C](#)
[Kortek KTW-N 26](#) [Sanwa PM1745](#) [Sanwa PM1745](#) [SI-327](#)

Need a cap kit? Most are \$5 on the "Parts Page" below.

[Cap Kit Price List](#)

Need a manual to go with the caps? \$8

Need to know what is involved in installing a cap kit?

CAP KIT INSTALLATION 101

If you're replacing caps in a monitor not shown here, and you have a digital camera, I would appreciate any direct chassis pics such as posted here, to help newbies & old hands ID their new game's monitor. The overview layout seems to be best as most monitors appear the same or very similar when mounted on the frame.

.....Happy Gaming *from* Bob Roberts.....

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Monitor Extension Cables

by Bob Roberts

Let me preface this with a little about what I call *Monitor Syndrome*, which is nothing more than preconceived ideas about arcade game monitors that almost everyone seems to have when they enter this hobby.

I guess the foremost one would be that somehow monitors are game specific. The first Q that comes to mind is...I need...I'm looking for...I need a cap kit for....etc for my Pac-Man monitor or my Phoenix monitor, as though each and every game has it's own specific monitor for it, and it alone.

This is not the case and there are only a handful of different types of monitors used in video arcade games. There are lots of different monitors with different scan frequencies used in any of a variety of applications, but for coin-op vid game purposes, there are only a few. They start out with old black & white one video input monitors, which you could use from one B&W game to the next, and then you had X-Y monochrome, X-Y color, RGB and now in more recent years VGA/SVGA have entered the picture. The most common monitors out there in the vast majority of video arcade games are RGB & the hobbyist is going to be working with standard resolution on the whole. There are some games from the 1980's that do use medium resolution monitors, such as Atari System II games, but overall the standard RGB monitor ruled the roost.

There have been so many manufacturers of RGB monitors over the years that I could not even ballpark guess at a number, but they all were one animal... that was capable of residing in any RGB std video arcade game....much like today's PCs that you would not think of going into a computer discounters store and asking for a Packard-Bell monitor for your P-B, when you can get any number of brands of PC monitors to just plug n play with your PC. I guess it has something to do with it being inside this tall video cabinet that makes a person feel as though it is a part of the whole & as specific to the game as a 327 Chevy engine is to a Chevy.

The fact of the matter is, that you can swap these monitors of like types, between all manufacturer's games. Another Q is...What was...or do I have the original monitor that came with the game. I couldn't say that as I unpacked them brand new in the shipping cartons. Many of the games came with manuals for 3 or 4 different monitors used in a run, and at that, the monitor you found in the game was not necessarily one of the ones covered in the manual. I remember one mfgr that was using Electrohome GO-7 or Wells-Gardner K4900 series very vividly, as the monitor that came installed in the game I uncrated was one made by a company called RGB Display.

Then at the distributor level you might have a change from a shipping accident or even their mishandling of the game...the new guy that removes the back & props it against the cab, backs into it, knocking it into the neck of the CRT, hearing that sickening sound of psssssssssss as the vacuum is released. Do they fool with putting a new CRT on that frame??? Most times it is cheaper to just toss another new monitor of their preferred brand on hand into the game & get it delivered & making money, while having a perfectly good chassis for testing or selling, or even replacing the CRT at some slow period in business.

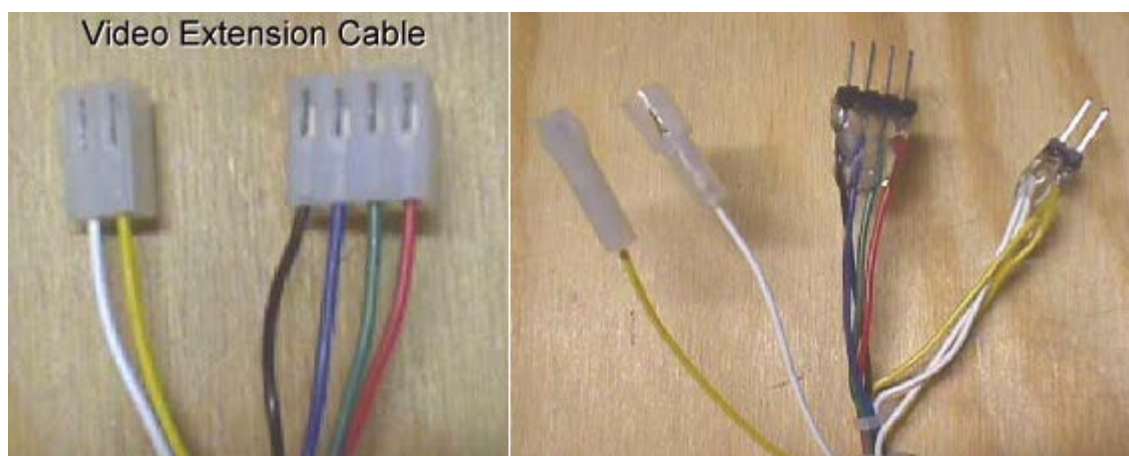
Now it's on the streets taking in those quarters...quarters...quarters! The op goes to collect his money & finds that one of his games has no pic. Does he take that game from the location for repair...losing those quarters, when he has some games sitting in the back of his place collecting dust... ones that never recouped enough money to pay for themselves...no way! He's got that good monitor, whatever brand or model it is, half way out of that cabinet before he even gets back to his shop, and within a matter of a few hours, it is residing in game X on location taking in those quarters again. Who's to say what monitor HAS to be in a game to classify it as original? You have a good picture that you are satisfied with.....it's original!

Well.... now that we know RGB is RGB, we also know that we have the means to do tests on the monitor out of it's cabinet & on a bench by way of an extension cables. The AC extension is easy to deal with. Just keep in mind that the monitor must be powered by the isolation transformer in the cabinet, so you want your power extension to simply

interrupt & extend the plug that is closest to your monitor, as this will be at a point beyond the isolation xformer....**DO NOT PLUG OR RIG YOUR MONITOR UP TO THE HOUSEHOLD CURRENT AT A WALL RECEPTACLE!!!!** You can hook up an isolation transformer on your workbench if you have one, but it is not necessary for a hobbyist to have a powered workbench, per se, since a majority of you can, and do, work from the cab & on those special occasions when you want to attempt a way-out-of-cab repair, it's usually on the new coffee table & you do not plan to fire it up there.

CAUTION: HAVE A FUNDAMENTAL KNOWLEDGE OF ELECTRICITY FIRST AND NEVER RIG YOUR MONITOR UP TO THE HOUSEHOLD CURRENT AT A WALL RECEPTACLE UNDER ANY CIRCUMSTANCES!! AN ISOLATION TRANSFORMER SHOULD BE USED WITH EVERY MONITOR YOU RIG UP TO WORK ON!! YES... THIS INCLUDES THE LATEST CHASSIS' THAT DO NOT REQUIRE ISOLATION!! ANYTIME YOU WORK WITH RAW AC VOLTAGES AT ANY TYPE OF WORK STATION BE SURE IT IS ISOLATED. THERE IS ALWAYS A SHOCK POTENTIAL PRESENT!

Okay...got AC...now you need an RGB video & sync extension cable. This is not only handy to work on your monitor, but it can be an extremely useful piece of test equipment teamed up with any other video game with an RGB in it, or even a spare monitor sitting around that you know is good...or maybe one that you just want to find out if it's good or not without actually installing it in a cabinet. I've been making & selling these extensions for over twenty years now, so let me place a pic here to save another thousand words.



As you can see above, the video lines color coded Red-Green-Blue-Black (video ground), are pretty standardized in order, whether you have 2 headers, a 6 position or 10 position single header on your monitor chassis, they will line up correctly. Exception: Hantarex 9000 is B-G-R, but knowing this, you need not even try to change the order to accommodate this model, since if you see the colors are reversed, but everything else is fine, it's done it's testing job for you.....whether it be monitor or a game board you are testing. Now the reason that the signals are divided up between the 2 position & the 4 position Molex .156 housings, & headers pins on the opposite end, is to accommodate all the different header layouts on the monitor chassis' themselves. If you have a single 6 position header on your monitor, you can put the 2 closely together to comprise an equal to the one being extended. If you have a Wells-Gardner K7000 which has a 10 position single header, you can put the 4 position on the first 4 pins & then the second 2 position syncs can be placed at the other end on pins 9 & 10. Actually, on the K7000, if you have composite sync you can feed pin 10 only.

In the pic, in the middle, you will notice that there is a bullet plug on the sync wires (yel & wht), and when plugged in, it simply combines the horizontal & vertical syncs to make a composite feed.

Let's take a game that you have that has a screwy looking pic on it... you want to know if it is the fault of the monitor or the game board. One way is to go from a working game in your collection to the unknown one. Take the backs off of the 2 games to be used & make sure they are unplugged from the wall...safety first! Let's be more specific about the games. Let's say your Ms Pac-Man with a GO7 monitor has the screwy pic and all you have nearby is a Bad Dudes with a WG K7000 in it. You know that your Bad dudes pic is great, so the signals coming from it are ok. This is a 10 position header type monitor, so you plug your 4 position header on the extension up to pins 1 thru 4 mating up to the color

coded wires already on the housing. Next you would see that you only have one white wire in position 10 of the Molex housing...that's composite sync & all that is needed to feed the K7000 ...so when you plug in your extension's 2 position header you'll have one of the wires going to an empty slot on the K7000 Molex housing. On the GO7 end, you need to feed both horiz & vert syncs or your pic will roll one way or the other. This is where the bullet plug comes in... if you plug it together, both wires going down to the 2 position housing for syncing the GO7 are now jointly fed with a composite sync. All that is left to hook up is the video & it simply plugs to the 6 position header of the GO7 from right to left covering 1-4 pins.

Now for the test...hmmmm...we don't need any power to the K7000, so you can unplug that monitor if you wish. Next, plug both games back into the wall outlet & turn them on. Your Bad Dudes known good pic is now displayed on your Ms Pac-Man monitor. Picture's not screwy anymore & looks great....you have a Ms Pac-Man PCB or wiring problem in the Ms Pac-Man cabinet. Bad Dudes pic is just as bad as the Ms Pac-Man pic was....you have a problem with your GO7 monitor.

This is a simple extension....the K6100 X-Y color with 15 position Amp plug is the time consumer, but oh so very necessary. I can't recall how many Tempests, especially, that came thru the shop, and it was so easy to roll that roll-about cart with a K6100 good monitor on it right over next to the game & facing the front....just a simple plug up of the extension & you knew immediately where the fault lay. If you had to yank the whole monitor for bench repair, it sure was easy to burn it in afterward without actually putting it back in the cab.... a heavy & awkward installation done one time only!

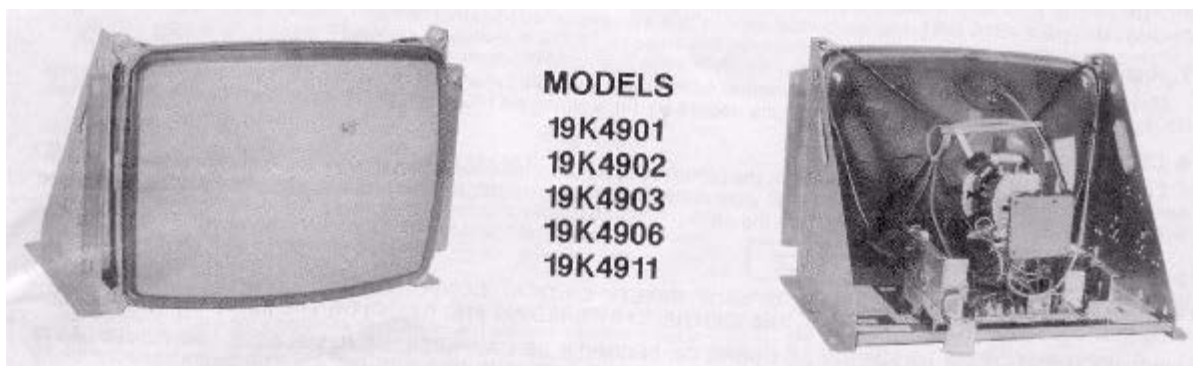
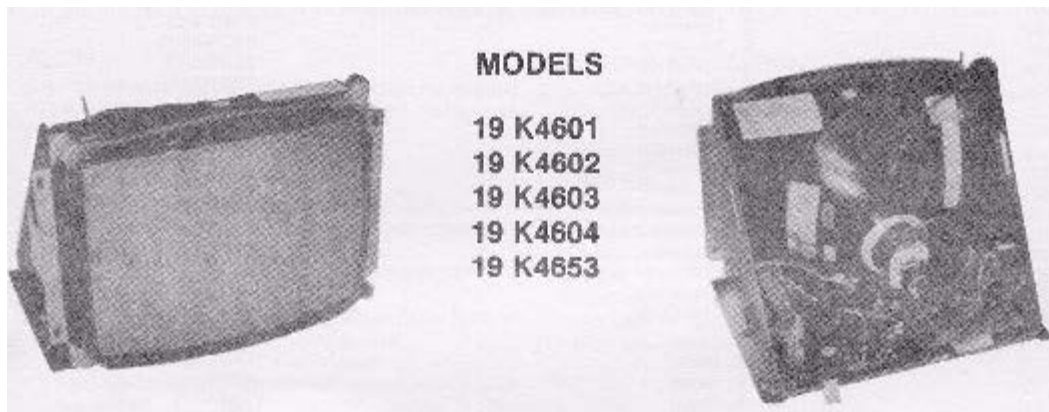
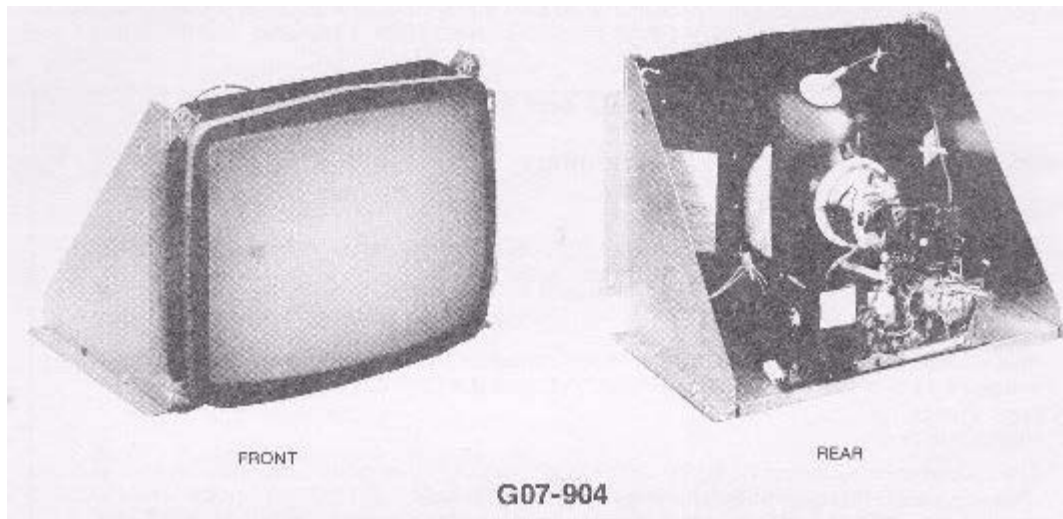
Happy Gaming.....

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Monitor Orientation

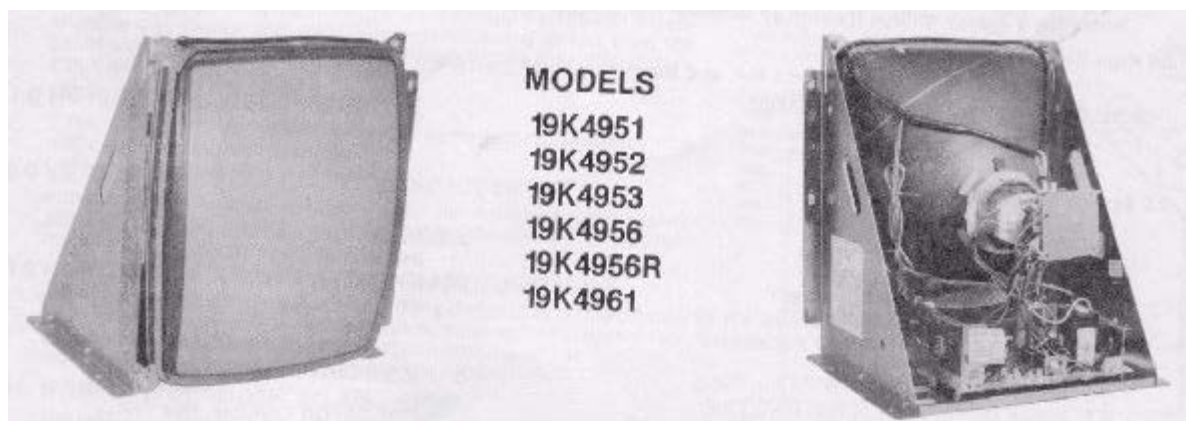
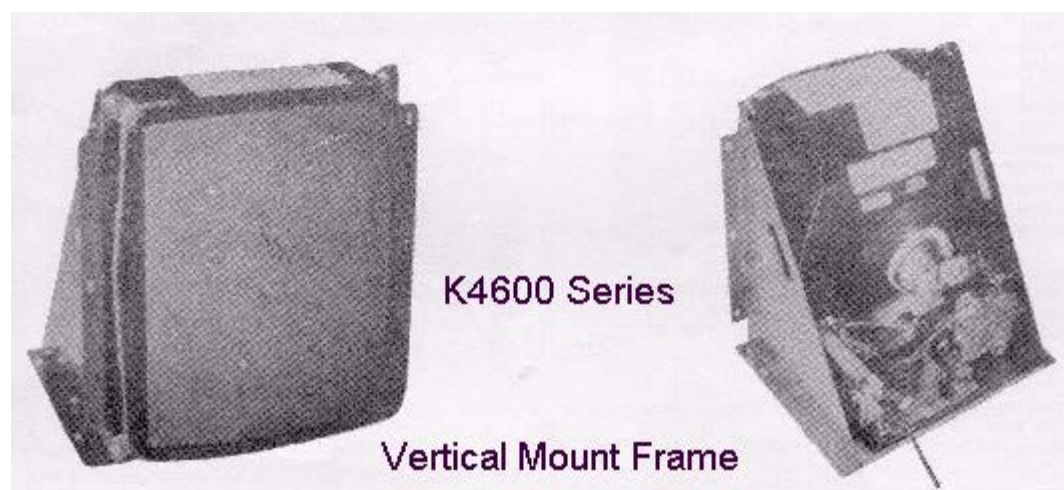
By Bob Roberts

Something that adds extra time to troubleshooting for newbies & old hands alike, is being confused about what is vertical & what is horizontal. Many make the mistake of relying on the monitor's physical mounting or mounting frame orientation, to describe a problem, while others say that they do not have any idea. I'm going to attempt to take some of the guess work out of the equation & I'll start with the frames using a few pics pilfered from manuals.



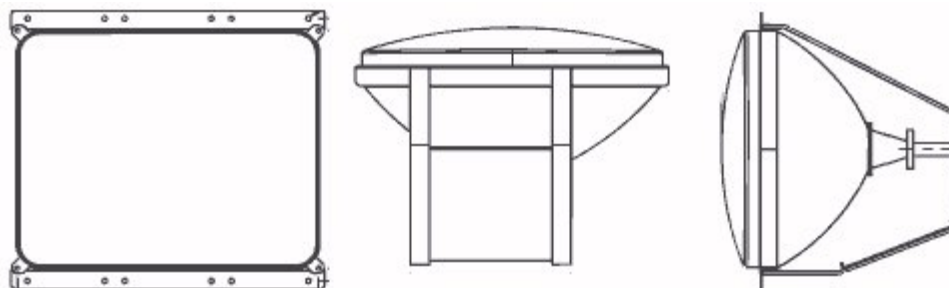
All of the above monitors are horizontal shelf mount monitors, meaning they are designed to bolt to a plywood shelf in a cab. They may also be mounted in either a vertical (longest axis in a north/south direction) or horizontal (longest axis in a west/east direction) position by using the predrilled flanges on each side of the CRT & some sort of cab framework... either

metal cross bars such as used in Pac cabs, Nintendo cabs & Taito cabs, or mounted to plywood as used in Stern cabs & many JAMMA cabs. There are many instances where this type framework simply cannot be used in the vertical position due to the space allotted in the cab... well... some ops use to make them work by cutting a hole in the cab back door to allow the excess framework to protrude & then build a plywood box around it, but it was tacky looking to say the least :-)



All of the above monitors are vertical shelf mount monitors. This version has the framework conforming to the longest axis making it more convenient in small spaced cabs, but it may also be mounted vertically or horizontally by using the long axis mounting flanges bolted up

to a wooden or metal framework adapting it to your cab. A good example of one being used in both vertical & horizontal apps would be in the Nintendo games where they used this type mounted to their own metal framework.

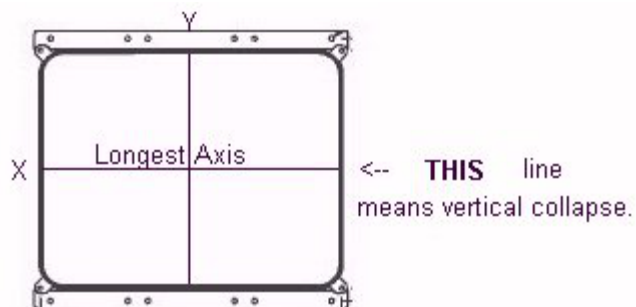


This is a typical universal mounting frame. It bolts from the front & since the rear frame work is much narrower than a shelf mount frame it will easily fit into a shallow space when mounted vertically in a cab, thus giving ample room for the back door to close. The chassis pan is typically mounted on the frame at the 30° angle, more or less facing the belly of the pic tube (CRT) .

The above universal mounting frame was popular with JAMMA games whereby you could mount the monitor to a square piece of plywood that could easily be rotated for either a vertical game or a horizontal game in the same cab.

Regardless of the frame type, when the CRT's longest axis is up/down & the narrowest axis is left/right the monitor is vertically mounted and conversely, when the CRT's longest axis is left/right & the shorter axis is up/down the monitor is horizontally mounted.

Now comes the answer to, "I don't know if it is a vertical problem or a horizontal problem?" This has nothing to do with the monitor type... just use the screen as your guide. Drawing mental axis lines from the very center of the tube to the outsides, much like the cross hairs of a scope, if you have a collapsed screen for the longest axis line it is a vertical collapse symptom & you should be looking at your monitor's vertical circuits for a cure.



^ **THIS** line means horizontal collapse.
This holds true no matter what position that the monitor is mounted in... rotating changes nothing.

A collapse over the shortest span is telling you to look at the horizontal circuits no matter the position in the cab, e.g., I hear often times with a vertically mounted monitor, such as in Ms Pac, that the line is horizontal, so they believe they have a vertical problem, which is incorrect since the line spans the shortest axis, it is a horizontal problem.

Hopefully, this will be of help in diagnosing your monitor problems correctly.

Happy Gaming...

Ms Pac-Man Rom Tip

By Bob Roberts

Now that eprom programmers these days are so inexpensive I see that many hobbyist have them. One of the oft asked questions I hear is, "Can I check my Ms Pac roms with my programmer even though it does not support or have the 2532 or 9332 roms listed?".

Well... if all you want to do is check them to be sure they are good & not the source of any problem you may be having with your Ms Pac bd it can be done on most programmers via the 2732 option. All this can do is read in a checksum for you & as long as you have a known set of good checksums read in via the 2732 to compare to, you'll be able to verify the chips as good or bad. I'll put a good set checksum list below for easy access.

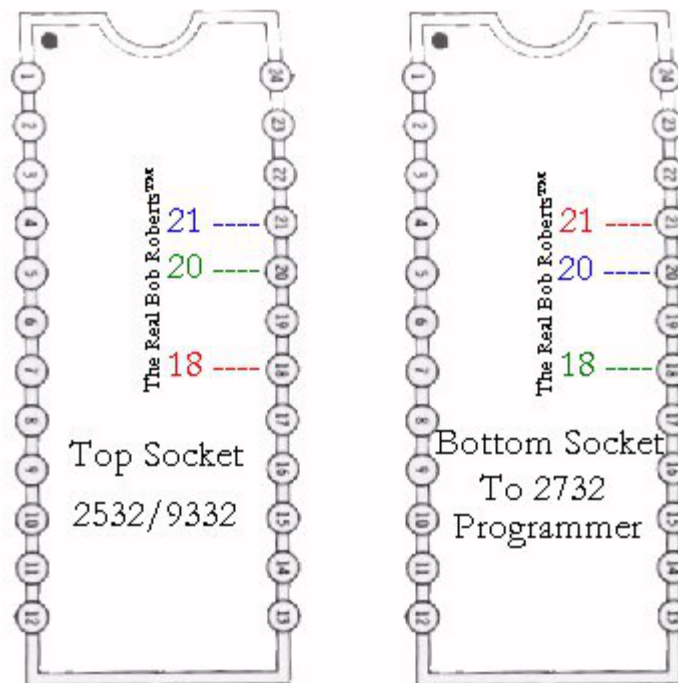
Letter	Position	2532-9332	2732 Chksum
A	6E	\$F400	\$89FE
B Normal	6F	\$B100	\$D706
B Fast	6F	\$B100	\$D706
C	6H	\$9A00	\$66AC
D	6J	\$A20C	\$F784
E	5E	\$D972	\$E11C
F	5F	\$A4B8	\$201E

Another thing that you can do, that I have been hesitant to post here, is make an adaptor. I've explained this probably a hundred times in email to start-up shops over the past eleven years, to experienced electronics people, but I didn't want be the cause of a hobbyist smoking their programmer. With so many of the newer programmers out there that do not support the 2532 I've decided to put one of the simpler ways here with the disclaimer that you use this information at your own risk.

Back in the crossover days of hard wired coin-op machines to electronic, I had to make adaptors for just about everything & soon discovered that there are many different ways to build a basic rerouter. In the case of the 2532 I built adaptors from elaborate ones on perf board with LEDs to expensive PCB types to just simple double socket ones that could actually be used on-board to sub 2532-2732 or vice versa. These simple ones were the ones most often used with the various programmers over the

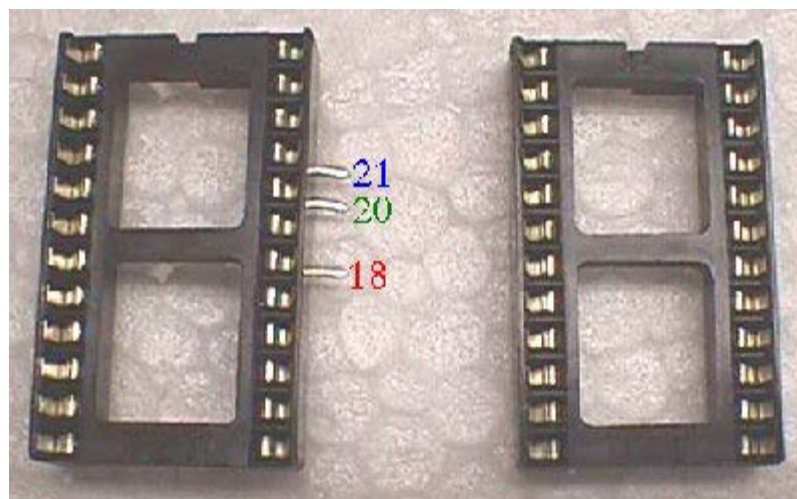
years, but with the use of a zero insertion force (ZIF) socket due to their frequent use. This is the one I'll go with since there is much less chance of an electrical snafu.

Basically, all that needs to be done is to redirect 3 lines... simple enough & I'll see if I can't make one of my great artistic attempts at an explanatory drawing to show the redirection here.

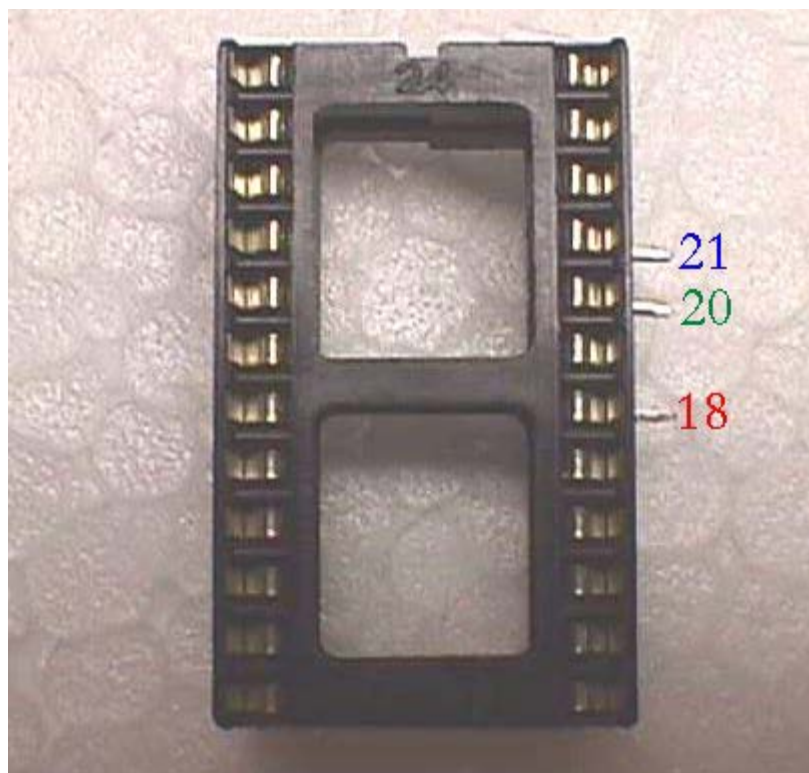


All you need for parts to build this is a couple 24 position IC sockets & a 24 pos ZIF socket.... how complicated can it be?

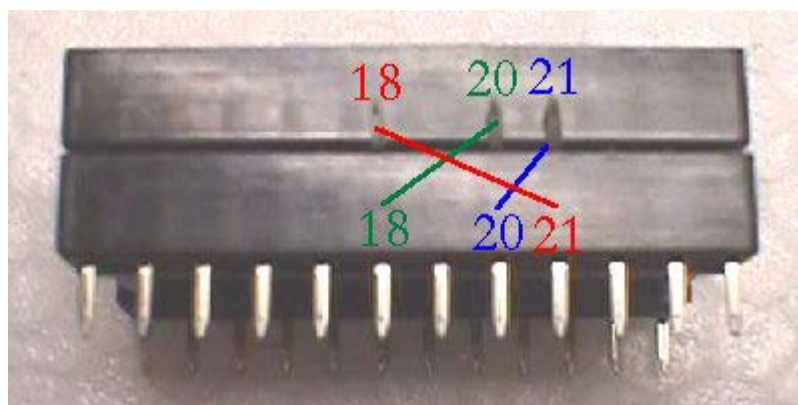
Take your top socket & bend the legs of pins 18, 20 & 21 out 90 degrees.



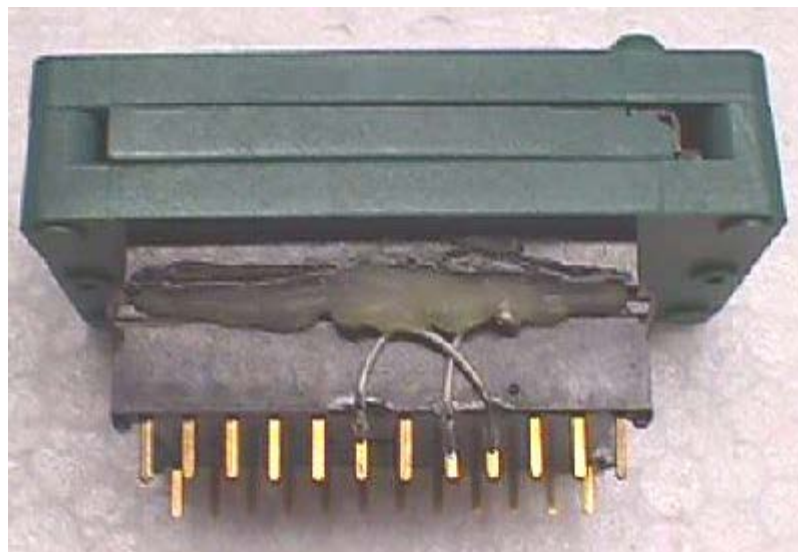
Insert the top socket into the bottom socket pin for pin.



Now use wirewrap wire to redirect the pins as pic'd soldering as close to the body of the lower socket as you can. This socket will plug into the programmer socket, so you need to keep solder as high & as minimal as possible.



Insert your double socket in your programmer for stability & then plug your ZIF socket into the top where it will reside permanently. Take it for a test spin to see if you get a good cksum on a 2532 or 9332. If all is working okay then I usually seam it all up with hot glue to be sure it doesn't come apart. Your finish product should look something like this.



The one above was built in 1987 & still works fine after all these years, so longevity should not be an issue with normal precautions in storing when not in use. I just pop them into styro & rubber band them. The rubber bands don't seem to hold up like they use to & have to be replaced often or they will break :-(I have much older ones that are still fine, as well, but they involved piggyback sockets for inversion chips to read masked roms. There is a pic of a few on my [Adaptor Page](#) on the Eprom Adaptor link.

On another note, I keep hearing that 2532 eproms are no longer available or hard to find. That's been the rumor about town for ...jeez...20 years, or so. I've not seen a shortage of suppliers for the 2532 & have thousands of them on hand myself.

Happy Gaming....

Pac-Man/Ms Pac-Man Speed-Up Chip

by Bob Roberts

For beginners (newbies) the best way to change this speed-up chip is to remove the pcb.

These directions are for the Ms Pac-Man upright (UR) machine, the most detailed and the others can be done easily by modifying these instructions.

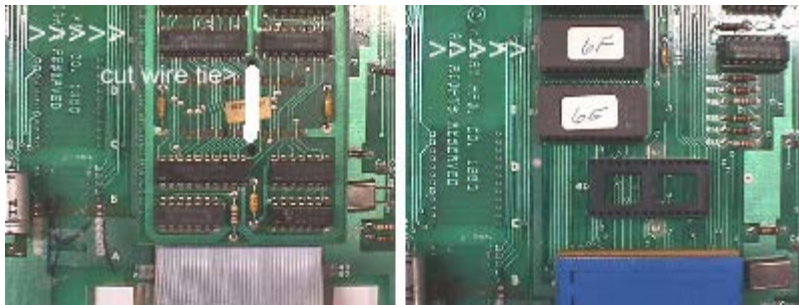
1. Remove the hex-head screws holding the plastic pcb mounts to the cabinet on the side closest to the back door & the short piece from the top, closest to the back door. The board will readily slide out now after unplugging the harness and taking note of it's direction....so that you do not reinstall it backward, you may want to put a piece of tape on the side facing you....but before you slide it out you need to remove the auxillary board from it's metal holder.

2. To remove the auxillary board, you will notice 4 plastic prongs, 1 in each corner of the pcb. You need to pinch the plastic lock in the center of each one of prongs with a pair of needle-nose pliers and gently pull the pcb corner toward you. After doing all 4 the pcb will be free and you will be able to slide the main pcb from it's holder.

3. You probably don't have a work bench, so you will need to put several layers of newspaper on whichever table your spouse will allow you to use. The component nubs on the solder side of the pcb are very sharp and will scratch you and the table, the reason for the newspaper.



4. It is best to lay it out with the ribbon & auxillary board facing you. In this manner you will notice that all the IC chips on the pcb & it's plug in satellite boards now have the small notch in the end all pointed to your left. These chips must always have their notches pointing in this direction regardless of any writing on the chips. Some chips will have the writing, especially if someone has replaced them before, upside down so you must follow closely the direction of the notches. Failure to do so, will result in a defective or blown chip at the very least.



5. The speed-up chip you want to install is under the small satellite board closest to the ribbon cable. There are 4 roms or eproms there marked on the board on the notch side as 6E/6F/6H/6J. The one you will need to replace is 6F. First, you will probably need to cut the wire tie that is holding the small satellite board in place.

6. Remove the small satellite board from it's socket by gently prying upward on one end and then the other, until it is free. So you will have no doubts, this board has on the notch side (to the left) the writing *Z-80 sync buss controller (285).

7. Using a small screwdriver gently pry between the socket and the chip 6F first on one end and then the other, back & forth until it has been raised from it's socket. You do not want to try to completely remove the chip with one try as you will bend all the pins on the other end of it. You also, do not want to shove the screwdriver way in under the chip & pry as you will scratch the traces (trails) on the main pcb.

8. Now you are ready to install the new speed-up chip 6F. Make sure it is facing with the notch to the left and line up the pins on the side furthest away from you and just barely into the socket. Next you can line up the pins closest to you and as you are gently pushing the chip into the socket, you may have to exert a minimal force toward the back of the board so that the pins will go in place freely. You want to be careful not to bend a



pin underneath the socket where it will not make connection or have a pin on the outside of the socket & not making connection.

9. Ok...your new speed-up chip is installed. Now the process reverses. Put the small satellite board (Z-80 sync controller) back in it's socket much the same way. Make sure the notches/writing on board are to the left and line up the back pins with the socket and in this case the front pins should pretty much fall into place so you just have to make sure it is in there securely.

10. Slide your pcb back into the cabinet and hang your auxillary board by the top 2 prongs loosely or snapping one into place. Reconnect the wiring harness and power up your game to see that all went smoothly before securing the pcbs permanently.

Note: The rom letters that corespond to positions are as follows:

A = 6E

B = 6F

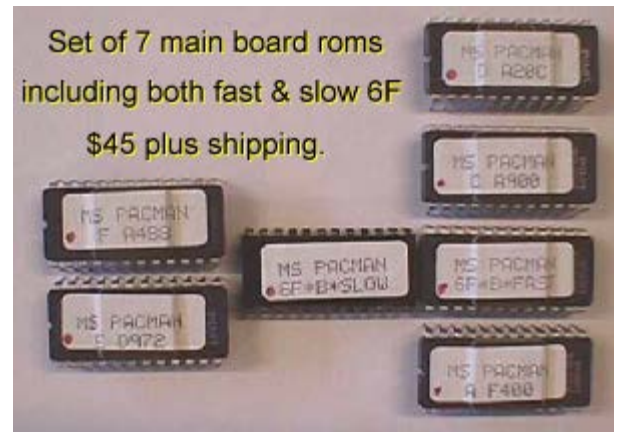
C = 6H

D = 6J

E = 5E

F = 5F

Happy Gaming.....



Roms-Proms-Eproms can be found on the "Parts Page"

All the help you will need with Pac games
can be found here:



[Help Page Index](#) Big Bear's Bulletin Board [Site Index](#)

Ms Pac-Man Wiring

Finally!! How to toss all these parts into a cab & come out with a working Ms Pac-Man Game. I've worked on this over an extended period & have tried to break it into three sections that will hopefully mesh together to get the job done.

[AC Wiring](#)

[AC Installation Into The Cabinet](#)

[DC Wiring](#)

My Pac Is Drunk

by Bob Roberts

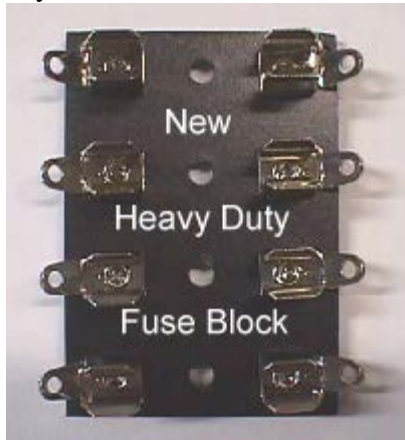
Pac-Man series of Midway Mfg Co

Symptom: Pac-Man looks drunk 🍷 🍷

Game plays fine, but (1) there is a faint band rolling through the picture (2) a heavy black bar rolling through the picture with a loud hum heard on the speaker (3) a thin band scrolling thru the picture with or without an accompanying hum (4) a flag-like, almost invisible weave/wave going across the picture.

Cure:

If you want to fix it one time & forget it, then change the 4 block fuse holder & Scotch-Brite



the fuse ends. Next, get a Molex 22/44 edge connector with split pins (same as Jamma) and cut the wires about a 1/4" up from the old never was a connector, one at a time & transfer them into the same positions in the Molex edge connector.



See "Crimp Mystery"

Solid Pac for a lifetime.....forget the caps on the pcb other than resoldering C7 & C8, as these sometimes have a cold soldered leg, about 2 percent of cases, but nevertheless a possibility.



When one of my ops has a Pac series trouble, you can bet it is on-board, because Molex keeps on ticking & the newer heavier fuse blocks last & last, unlike the flimsy ones originally installed.

As you can see from the picture of 2 old Amp Pac connectors at the left, the weak solid, but flimsy pins in the Amp housing are very stressed & scorched. In fact, only 5 or 6 pins are still clean & tight looking, which is what is needed for a good connection for the AC to pass through to the pcb unscathed.

This connector can cause many other symptoms in the Pac series from intermittent troubles to missing a color, or even a few cases of it causing a no sound symptom. The most common is the 60hz hum bar in whatever way it chooses to manifest itself, though. I've even found it to be the cause of losing video altogether in a case where a tech brought the whole game into the shop complaining about the monitor not working in it, but working fine in another game in his shop. He was sure he had some sort of wiring trouble in the cab that he could not find, and in fact, it was a wiring problem since this edge connector was causing a floating video

ground to the monitor.

The parts necessary to do this are on the "Parts Page". The fuse block is \$4.00 & the Molex connector is \$15.25 and purchased together they are \$19.00 plus shipping.

Happy Gaming.....

All the help you will need with Pac games
can be found here:



Rams-Roms-Proms-Eproms can be found on the [Parts Page](#)

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Pac Series Adaptors

by Bob Roberts

Let me start with a little history & you can skip on by this if you want.

In the 1970s & early 1980s we had no vid game system in place such as the JAMMA system of today, so our test jigs were very basic with each portion terminating to a specific plug, i.e., a 15 pos Molex connector for input to control panel, a 9 pos for video input, dual 6 pos Molex for power output & a 2 pos for the speaker...the reason for breakdown was to utilize, e.g., the speaker for testing an amp, without needing to use another 15 position plug for only 2 wires.

You can see where this is going, each game pcb that came into the shop, had to have a hard wire configuration made up from whatever I/O connectors that that specific game had, to the test jig Molex I/O. Needless to say 4' wiring harnesses were piling up as each different pcb came in to be tested or worked on.

Now along comes Konami with a system that our first 18/36 harness built would work with many boards & they kept coming...more & more...WOW a unified system. Let's run with it. Now we have to make adaptors from game X, Y & Z as they come in to adapt to a Konami harness & we can use adaptor cards. Can it get any better?

Well, of course it could, and Konami..the innovator of the concept..had to join ranks with the others to satisfy larger I/O needs and bigger & better vid games in this new fangled system called JAMMA. Umph! Now we need to go with JAMMA adaptors & hook up a JAMMA harness to every jig in the shop.

Well I started by having the adaptor card fingerboards made right here in New Orleans where everything cost a fortune, and by the end of 1986 most all the old commonly used harnesses had been adapted to this new system. The first design....similar to the ones I use now from Andy's House of Adaptors....was off by a bit, since I only made provisions for up to a 22/44 pos edge connector on the adapted side :(Who knew that mfgers would see this 28/56 connector as an opportunity to start making up their own pinouts to it...jeez...now I needed 28/56 to 28/56 & they wanted my first born child and the next ten years profits to make up the fingerboards for me. My first reaction was to say, "excuse me, but I don't want them already prewired" to which I was given a song & dance about the cost of design going up & etc..etc.

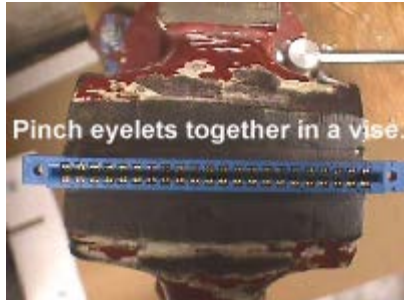
Enter my savior...John Robertson of John's Jukes had already gotten some made up & they would save me \$2 on each one at \$10 each at that time. Well, the adaptors continued to be made for each game that was to go on location that was not JAMMA. Many a Ms Pac-Man & Galaga were adapted to 25" JAMMA cabs & put on location.

1999 & now collectors & just plain game players want to adapt games to JAMMA cabs and Ms Pac-Man seems to be one of the big stumbling blocks that was overcome back around mid 1986 and without all this damage & hacking to the pcbs. An op could take his Pac series pcb with him & put it in a dedicated game or a JAMMA cab & have it work equally well with only sometimes having to turn the +5 volts up a tad...and they marked one that had to go up, so that when the next route collector went to change the pcb, he knew to turn the voltage down. This was not very often, and we were using 7 amp switching power supplies at the onset...today there is no need to set the 5 volts high with these 15 amp power supplies.

I've tried to explain this to several people, but they can't get by the theory factor, which I threw out over

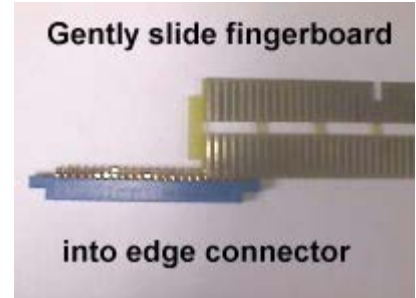
40 years ago when I got my first job working for a distributor. They said if you want to continue working here, you're going to have to get all those college ideas out of your head and start from scratch in the real world. I did & have owned my own businesses for 40 years now, so they were right.

Now I have this Sony digital camera to take pic's as I go, so that it is seen, as well as read. Here's how to make an adaptor for Pac series. BTW: In electronics, it is adaptor rather than adapter which might apply to a plumber's trade or others, although I guess it really doesn't matter, since anyone in electronics is going to know what you are talking about.



The one thing you want to do when making an adaptor for a Pac series is to put plenty of 18 gauge wires to ground & to the 5 volt inputs (old 7VAC) as the more you put, the easier the voltage/current travels to the pcb by the simple ohm's law principle of parallel resistances lessening the total resistance, which people find hard to believe in these

little wires, but there is no place that proves this theory any better than on these adaptors.

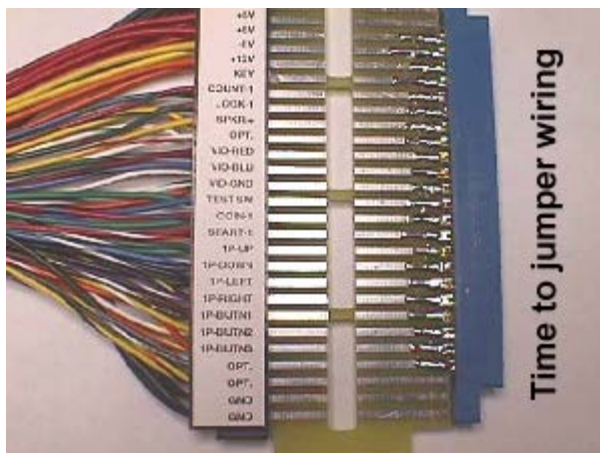


The pic's above are self-explanatory and are the first steps to getting this adaptor under way. In the pic at the left, you will note that the tip of the pliers is underneath the card to hold it level. You can see it better in the pic on the right which shows it after being tacked in place first before continuing to solder all connections..just in case you need a little

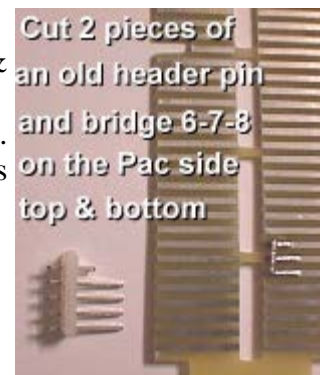
adjustment. Be sure to tack both sides...one at each end & one in the middle.



TIP: This applies to any adaptor cards you are building....if you get the pinout printed out on an 8.5x11 piece of paper you can fold it right down the middle so that you only see the side you are working on...solder or parts...and this reduces the chance of error by a large margin.

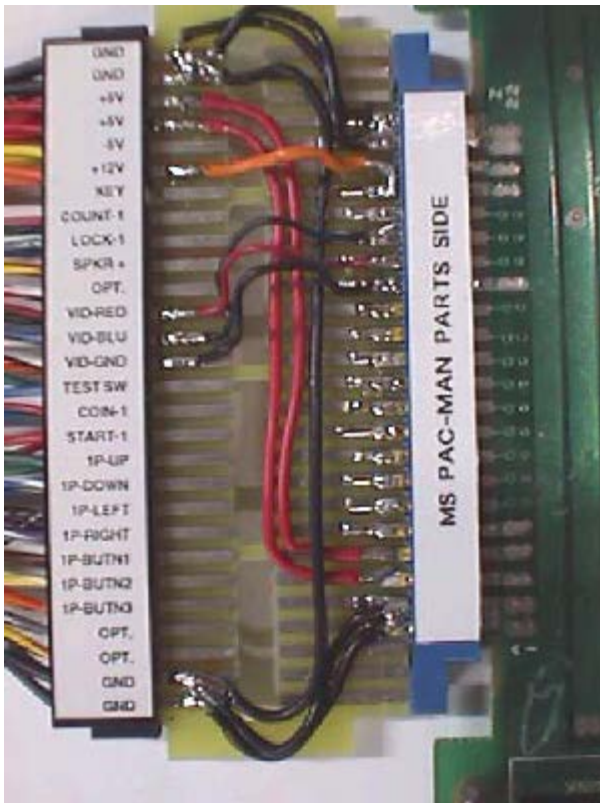


The foolproof way is to get an old labeled JAMMA connector & place it on the JAMMA side of the card, like in the pic to the left. Make sure that you have the parts side up for the Pac side & you'll need the pinouts for it, as well, but before you get started, you have to make two bridges on the adaptor card. One shorts out C-D-E on the parts side, and the other shorts out 3-4-5 on the solder side. It's easiest to count up from the bottom of the actual fingerboard to



positions 6-7-8 on both sides. Perhaps the pic will be a more concise way to show it. As you see in the pic in the upper right, it is much easier to look at it than it is to describe it. Do the same on the flip side. Once this is done, you can run the power wires as below. I'll put pinouts to power wiring, but the rest will have to be done from a pinout sheet.

In the pic on the left you will see that the DC power lines



are easiest to run first. On the parts side as depicted, there are 3 ground wires leaving the Jamma pins 27/28 made into a single pad with 2 lines going to A/B on the Pac side, also padded to form a single pad, and the 3rd wire goes Jamma 1/2 which ties the 2 ground pads together & then it also has 2 grounds leaving the Jamma 1/2 to go to the Pac side pad of Y/Z. The 2 red 5 volt lines form a pad at the Pac side C/D/E & run up to the Jamma side 3/4 pad. Lastly, we have the 12 volt orange wire going from Jamma 6 to Pac W/X pad. I've found that even most techs stop at this point & figure that there is enough wired in for power needs....not true...much more is needed. As I said, you want more parallel lines in, the more streams you can put into the lake (PAC), the more you will lessen the resistance by dividing up the load going into the Pac board. This will make the job of your switcher very easy to do with no strain at all and providing ample power to drive the board. When finished, this also produces a side effect of reducing all the heat that emanates from the board itself, especially reducing heat off from the rams & proms which often times are hot enough to burn you.



Lets power out the solder side now. In the pic to the left, you'll see what the solid jumpers & 18 gauge wire do at C-D-E & at 3-4-5...essentially the same thing you are doing by jumpering diodes on the Pac board itself, but without harming the integrity of the board. Ok...the backside power wiring is a little different. Starting with the ground pad at Pac 1/2, the first wire goes to the Jamma pad e/f while the second wire goes to Jamma pad A/B. The ground pad at Pac 21/22 also splits with one wire going to Jamma pad A/B while the second wire goes to Jamma pad e/f. A crisscross ground layout with all double connections made into a single pad. The 2 red 5 volt lines on Pac pad 3/4/5 run up to the Jamma pad C/D

where there is also a 3rd red wire leaving this 5 volt pad & connecting to the Pac single pad at position 18. All that is left for power now is the second 12 volt input which goes from Pac pad 19/20 to the Jamma single pad F.

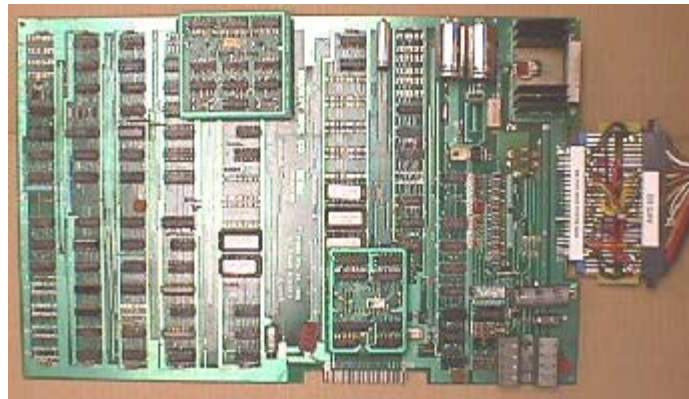
Well...filling in the rest of the wiring is fairly easy & straight forward & a 20 gauge wire should be ample for any remaining connections. After I finished this one I performed tests on it in 3 Jamma cabs with the same results in





each one with different Jamma pcbs. The first test was with a Double Dribble whereby I set the power supply to deliver 5.00 volts to the edge connector. I then powered down & moved the

Jamma harness to the Pac board & repowered & measured the voltage at the Pac edge connector. It measured 5.10 volts & the Pac played fine & ran cool. I repeated this with a Plotting & a Neo 1-slot with the exact same results. With the parallel system in use, I actually deliver more voltage to the Pac board than I do to the Jamma boards.



The parts necessary to do this are on the [Parts Page](#) . If you want, I can make you up a kit of the fingerboard card, 22/44 pin edge connector...SE type...and a bag of new wire clippings from harness building leftovers for \$8.50 plus \$6 shipping USPS Priority.

Happy Gaming.....

All the help you will need with Pac games
can be found here:



Rams-Roms-Proms-Eproms can be found on the [Parts Page](#).

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Pac-Man Switcher

by Bob Roberts

Yes! I've been working a minute or two here & there since the beginning of the year & I am close to finishing up on this adaptor to power Pac-Man & Ms Pac-Man cabinets with a switching power supply without hacking the cab's wiring. I simply do not have a minute to spare to offer these as assembled, but will be selling them as kits for you to assemble & install a switcher in your Pac cab as so many of you have asked for. I'm just looking for a few hours to assemble one with pics to paste up here & it will be for sale after that.

It's about time to complete this assignment!

Once again I am surprised at how time gets away from one... days turn into weeks, weeks turn into months and before you know it, those months add up to a year. It's been 15 months now, since I had all these parts ready to go, including an old clunker Ms Pac-Man I picked up just for a working model to use for pic's to accompany this rambling. I mean, even the fingerboards were cut & drilled, but I just hadn't been able to squeeze out the time needed to do this. Well... this Memorial Day weekend I decided I just had to make the time to do this or it would never happen!

In starting out I ran into the typical things with the Ms Pac & figured since I had the digital camera at my side I might as well doc the jump start of this poor old decrepit, warehouse-aged & most assuredly, non-working game. *Click here to skip this preparation & go directly to the [Pacpower Adaptor](#).* I started off by cleaning out the bottom of the cab.. something you should do before applying power to any game that you've just bought or even moved from your own garage into your game room, as loose metal pieces of all sorts are lurking around the bottom just waiting to short-circuit your game & your hopes... nuts, bolts, washers, screws, nails, gum wrappers, cigarette wrapping foil (you know, the stuff ops use for new fuses :-) metal knockouts, coin diverters & this is just the metallic objects! Hmmm... we know how all those swizzle sticks got in the bottom, but how in the world did someone get Twinkie wrappers, potato chip bags & the like through that little coin slot!

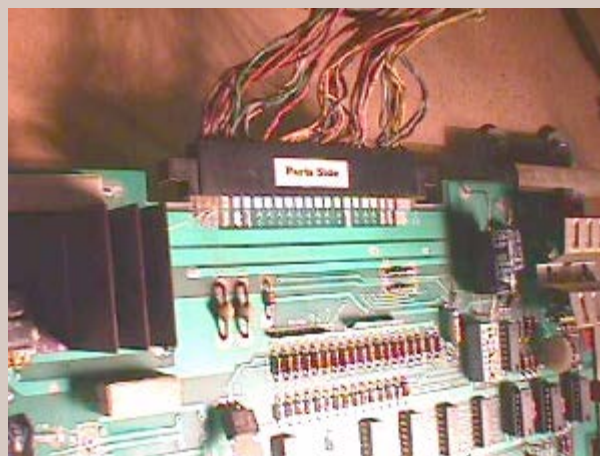
K... I got all the junk out & did a visual inspection of all the connectors & wiring & everything was there & didn't *look* too bad, so I grabbed a new power cord to see what I had... a bit antsy after a 7 year hiatus from the repair scene, but I was hoping to get lucky. Did I? Did you win the lottery this week :-) It roared on alright... that deafing hum that tells you that it's time for a new fuse block & edge connector, but I waited for a sign of pic tube life & when it didn't emerge I hit the coin trip switch. Ah... sound.... game works... ugh! A G07 monitor, but that flyback looked real strong & I can see the warm glow of the CRT filament, so it's time for a quick check of the tube by killing the shop lights. Ah... there's Ms Pac running around in the dark. Turning up the screen control washes out what little pic is visible. This is not good... all colors so low that you need the lights out to see anything even with no gray plexi in place. It's time to get the CRT tester/rejuvenator out & dust it off.



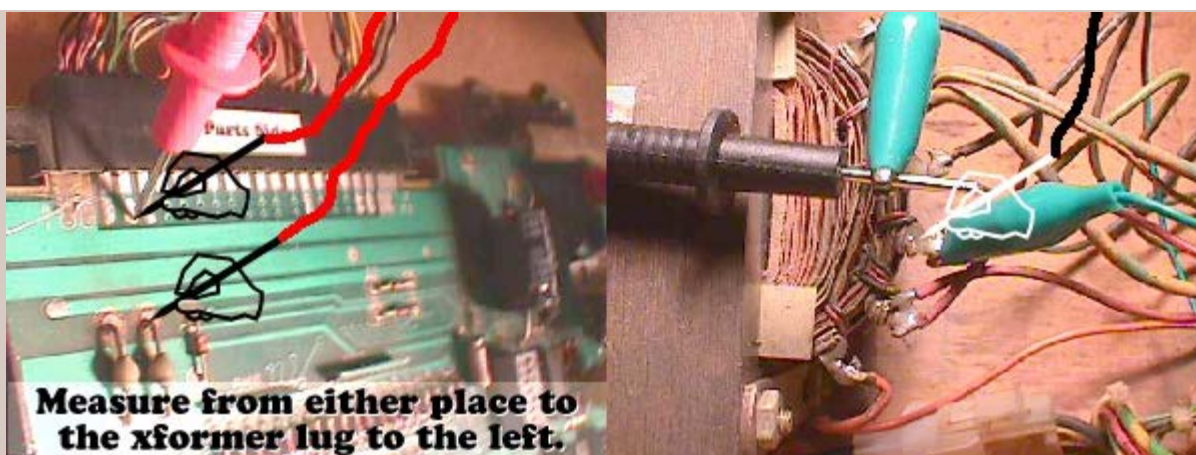
Another tube has died from lack of use. This is one more good reason for me to be working hard in retirement... so I don't rust up & start up with the low emissions... yikes! I don't know how many times I've heard that the monitor that I just declared dead was the best pic that the owner had ever seen before it went into storage. Oh well... I'll see if my luck with rejuvenation is any better than it's been thus far :-)



Call me lucky!! One boot a piece for the 3 guns & they're looking healthy at 1.2 all around. Time to listen to the hum again because I have to see the results. Hummmmmmm..... yes! The pic is as good as it was when it was new... well, almost... but hey... these characters aren't suppose to be breaking up all over the place :-(Here's where I take 2 hours off, take the game board to my work bench & get out my trusty 2 lb maul to reseal all those chips. A little stitching up with some wire wrap wire & it's as good as new ready to go to work again. Let's see, so far the monitor is bad, the game board is bad, the wiring is bad, the connectors are shot, the fuse block is shot, the fluorescent light needs the works to revive it, needs a control panel complete & a coin door complete, the cab needs overhauling... wow, what a treasure I have found :-) This is sure gonna be fun, I can hardly wait.



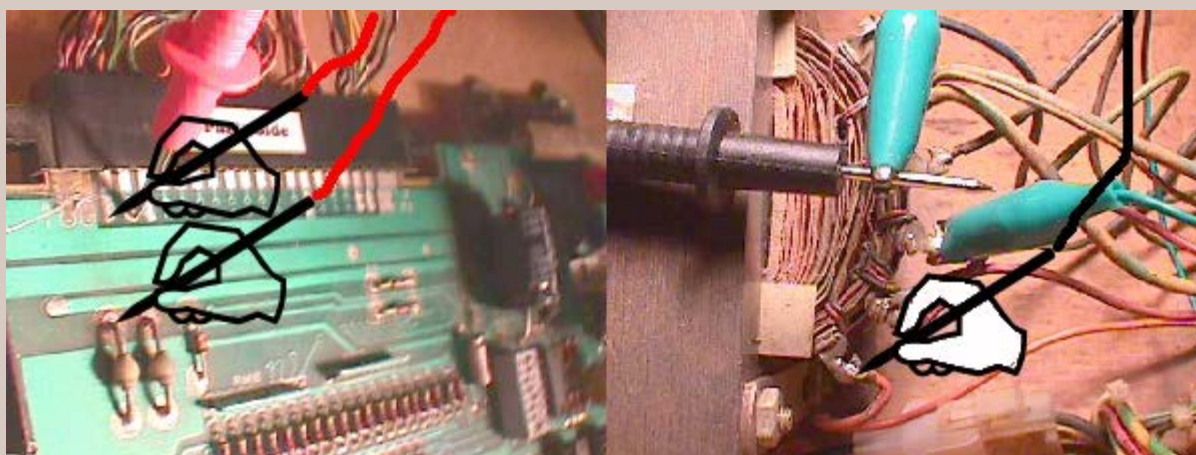
Here's something that I always do before ever taking that old Amp wannabe edge connector off the board and that is to put a *parts side* label on it. There is no end to the number of times that a Pac connector has been put on backwards. I had a tech stop by last week that has been making his living for the past 30 years in coin-op & what does he ask me... what kind of problems should I look for after plugging up a Ms Pac harness backwards & having everything go dead? I told him if he was lucky.... luck seems to have a lot to do with coin-op repair :-)... all he would need to do is change the fuses, and he was, but shouldn't he have known to check the fuses in the first place. Sometimes it's the simplest of things that get overlooked by even the pros.



Onward with the repairs... the quad fuse block & new real Molex edge connector need to be installed next, but lots of you ask how you can test to be sure that you need this done. If it's OEM, it needs to be done, but if you want to see anyway, all you need is an ohmmeter to check the continuity of the wiring from the time it leaves the xformer till after it enters the game board. In the pic above you can see that if you put one lead of the meter on the xformer's 3rd lug which has a green wire attached, and you put the other lead on the board's "D" pad, or the anode of A7 as shown, you are measuring the continuity of the green wire, through the 2 solder joints of the fuse holder, the fuse holder, the break plug just before the edge connector, through the edge connector & it's terminal (pin) right to it's destination, so if you get an infinite reading you know that leg is open somewhere along the the way. If you measure more than 1 or 2 ohms you know that circuit is in trouble. Here are my results below.

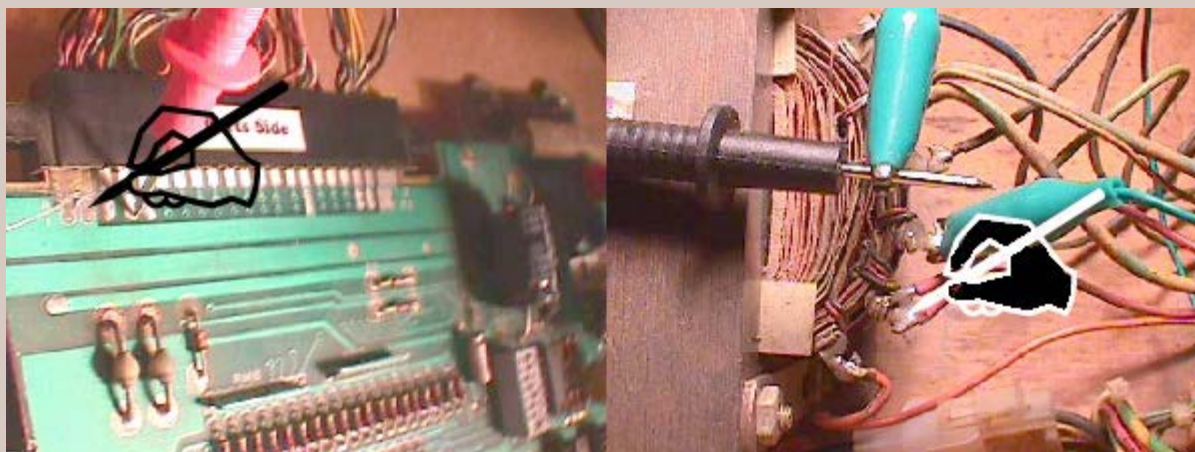


On the left is what the green path looks like & on the right is what the orange path looks like measured from the first lug of the xformer with orange wire attached, to the board's "C" pad or anode of A8 as shown in the pic below.



In the case of this Ms Pac where neither line is completely open, I suspect that one or both are opening up as soon as

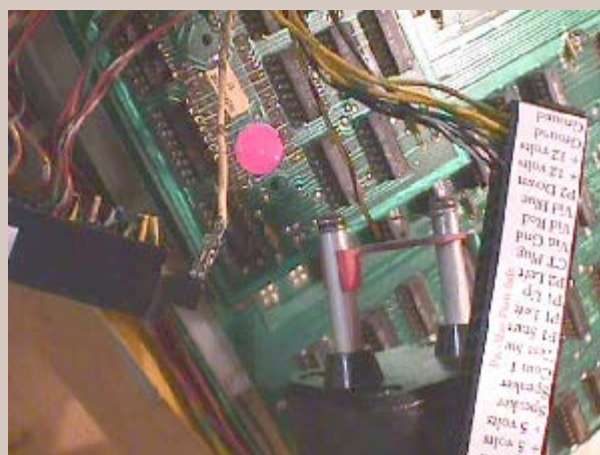
current attempts to flow because of the loud audible hum usually attributed to an open line. Pull one of your 7 volt 5 amp fuses from the holder & power up if you want to hear the hum. Normally, with readings of 8 to 10 ohms on these lines it only produces a slight hum accompanied by hum bars in the pic... black bar drifting through the pic.



The pic above shows the final path to the board... the center tap between the green & orange & going to ground on the game board. This red wire when connected to ground divides the 14VAC output into two 7VAC supplies.

K... I've changed the fuse block & I guess I have to change the dreaded edge connector next. Both of these have been doc'd elsewhere on the BBBB, but I'll take another pic of the connector being changed out while I'm pausing here.

Good Lord! I hope y'all are still awake... looks like I've put Alice to sleep with all this rambling :-)



The pic above shows the old connector hanging with the first half dozen wires transferred over to the new Molex... one at a time to ensure no mistakes... and you can see the one wire in mid process of moving. Briefly, the process is to snip a wire about a quarter inch above the old connector leaving you a color code on the old one that may come in handy if the phone rings, and it also gets rid of the stressed wire going into the old terminal. Next strip the wire end back about a quarter inch & crimp on a shiny new Molex split pin & insert it into the Molex housing in the same position as it was in on the old connector. When you're all finished you can compare the new to old in a side-by-side fashion to see that all wires did end up in the same positions as they started in.

After a sucessful transplant I took the measurements over again from the xformer to PCB & all results were the same & you can see from the pic below the proper reading for a good pathway.



Alrighty then! We've got a good working Ms Pac-Man to procede with the conversion kit assembly, so I guess it's time to go back to the workbench & put together the adaptor... without the use of the 2 lb maul this time! I like to put a thin cardboard sheet on the bench to work on to make cleanup a snap. It might work for you, as well.

Step 1

The first thing to do is cut all your wires to length & prepare them so that the project will flow along smoothly when you get to the stage where they are needed. You're going to need them cut to the following lengths:

- 2 Orange 18ga cut to 18"
- 2 Black 18ga cut to 15"
- 2 Black 18ga cut to 18"
- 2 Red 18ga cut to 15"
- 2 Red 18ga cut to 18"



Strip back one end of all wires approximately a quarter inch & tin them with solder & set them aside for now.

Step 2

Take the 22/44 position solder eyelet edge connector & pinch the eyelets together, so that they form an upside down v the whole length as in the pic on the left below. Incidentally, I'm often asked why I use solder eyelet edge connectors rather than the solder tail versions that are a fraction of the cost & the reason is that solder tails are made to mount on a PCB which will equally divide the stress among all pins & keep them in a straight back position & they simply are not strong enough to use as a stand alone connector. You would have to change it again the first time one of those thin pins broke off flush with the housing :-)



Notice that the fingerboard has 5 finger traces drilled out on one side & only 4 on the other. Take the fingerboard with the 5 interrupted traces to the left top as in the pic above right & gently feed it through the gauntlet of pins as shown. Make sure that your parts side of the SE EC is also facing toward you.

Feed it all the way to the end & line up the eyelets over the traces on the fingerboard as shown in the pic below. If you have an adaptor aid use it to hold the other side of the fingerboard level so that you can tack solder the 2 outside pins on each side of the SE EC or if you don't have one, you can use anything that will slip under the other side to keep it level.

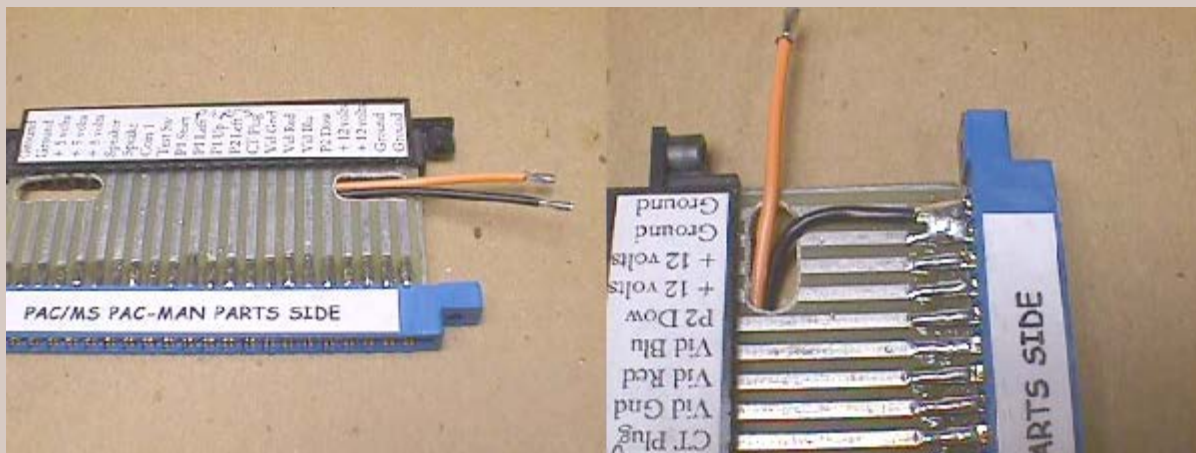


Now turn the the whole thing into a vertical position so that you can eyeball it to see if it is perpendicular as in the pic below left. If it's good to go, just start soldering all pins to the traces on both sides. Note: Don't use a soldering gun on this & don't leave your soldering iron on each position long enough to melt the plastic :- (The proper way is to heat the trace near the pin so that your solder will melt & flow into the pin & through the eyelet. If it is taking a bit of time to heat enough to flow the solder, then you should move the tip back & forth over the pin & trace trying to get it to flow in the least amount of time. If you're running into trouble it's best to just move on to the next one & come back to the troubled one after it cools down for a second shot. Before moving on to step 3, a visual inspection to be sure that no solder has flowed two pins together would be a good idea. You'll have to repeat this step when finished, as well.



Step 3

Retrieve 2 18" black & 2 18" orange wires from the stockpile that you set aside earlier. Take one of each color wire with the pre-tinned ends & feed them through the hole that interrupts the 4 traces on the right of the fingerboard as shown below. Take the black wire & position it on an angle to cross the last 2 positions on the fingerboard & solder it in making a jumper pad, so to speak.



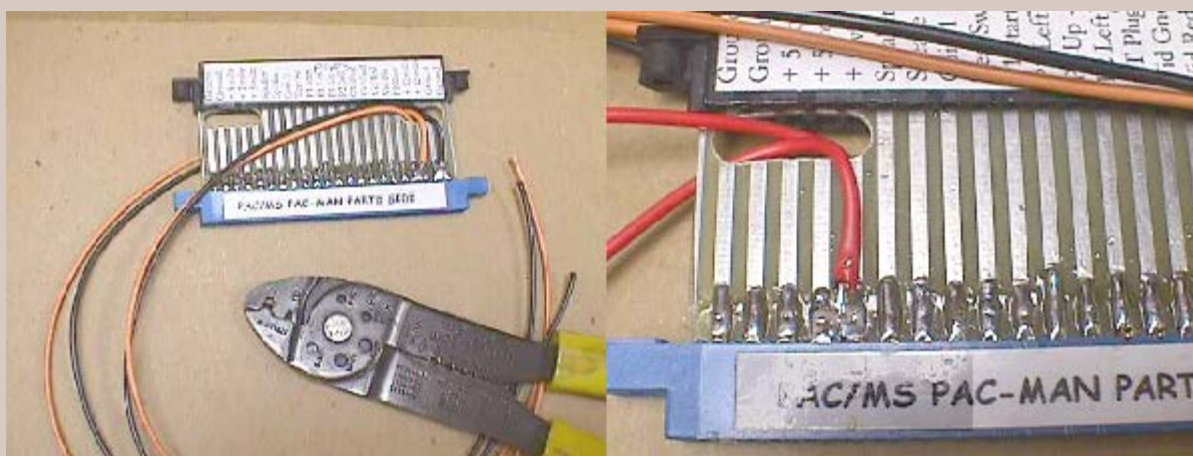
Now repeat the process for the orange wire soldering it across the 3rd & 4th pins to make a jumper pad as shown below left. Once this is done you flip it over & take the remaining orange & black wires & feed them through the same opening & solder them into like pads on the solder side of the SE EC.



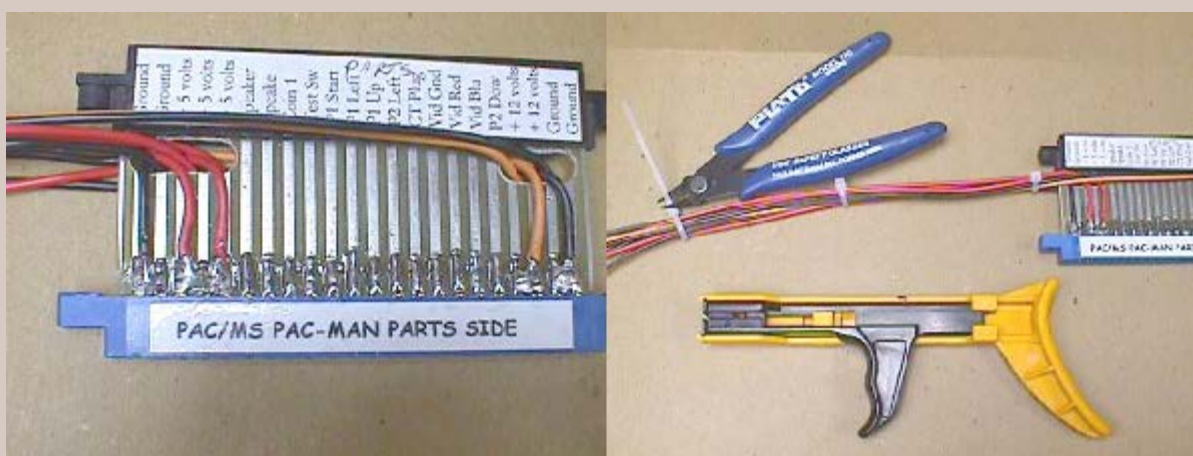
Step 4

Let's move to the other end of the fingerboard now. Retrieve your 2 18" red wires & feed the tinned ends through

opposite sides of the hole that spans 5 traces. These will be soldered diagonally across the 4th & 5th positions on both sides as shown below right.



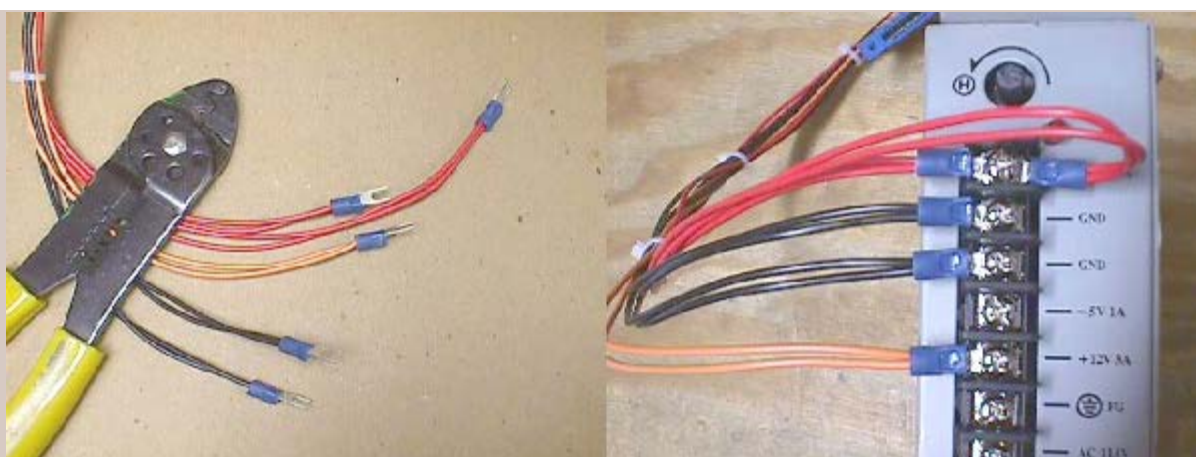
If everything is going as planned, you should have 2 15" red & 2 15" black wires ready to go. Crisscross the 2 red 15" wires through the the opening & solder each diagonally across the 3rd & 4th positions from the end to form a 3 position pad closing the 3,4,5 positions into 1. You should see the last move by now, but here it is... crisscross the remaining 2 15" black wires through the opening & form a pad in the same manner across the 1st & 2nd positions on both sides ending up with twin sides that look like the pic below left.



Step 5

Pull all the wires taut and put a cable tie at the edge to hold them snug. If you don't have a cable tie tool you can use shear cutters to grab & pull the ties tight by utilizing a loose grip on the handles so that you don't cut through until you have them as tight as you want... then snip! Put a cable tie about every 4" which usually works out to be a hand width apart.

Pair up like colors that best match in length on the unterminated ends of the wire bundle. You should have 4 pair of the same length & one pair of red wires that are a little longer. If any pair ends up with one of the wires being a quarter inch, or so, longer than it's mate, just snip off the excess to make them equal.... not that critical. Strip back each pair of wires about a quarter inch, twist them together & crimp on a spade connector. It should look like the pic below at this point & the adaptor portion is ready to use :-). Do a final solder splash scan to be on the safe side.



The leads hook up to the switcher as shown in the pic with the orange going to the 12 volt terminal, the two reds to the +5 volt terminal & the two blacks being split up between the two ground terminals.



Oh yeah!! Fits like it was planned all along & not just some blind luck :-)

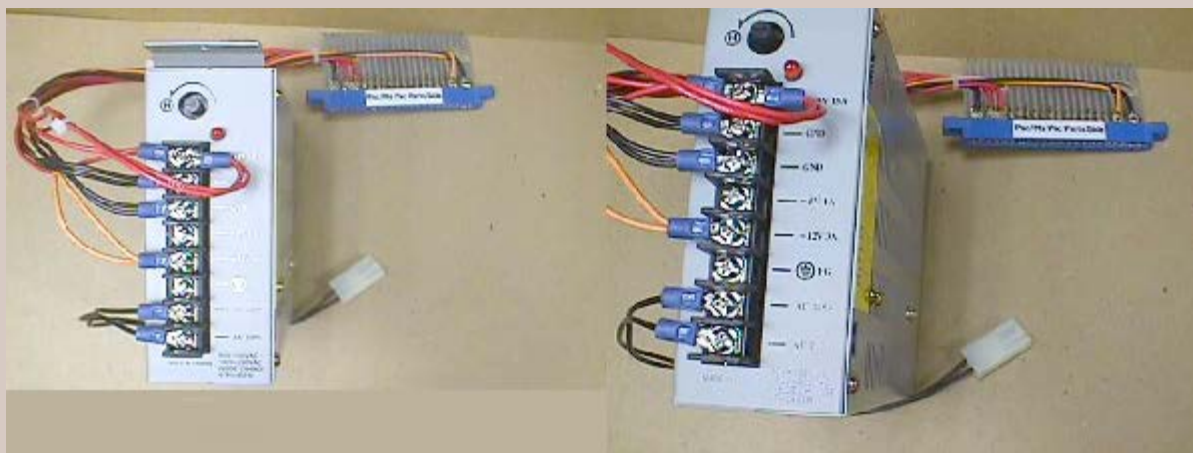
Step 6

Time to make an AC power in cord. Cut two 14" pieces of black wire & strip back all ends about a quarter inch & cable tie them together. Crimp spade connectors on one end of the pair & on the other crimp on 2 Molex .093 pins & house them. Remember from wiring up other projects... pins on the dead side & sockets on the live side, always & you'll never have one of those unexpected shorts arise in the future. As one hobbyist put it, the voltage receiver gets pins & the voltage giver gets sockets :-). Whatever works for you is best.



Cut 2 more pieces of black wire 24" long... or 2 feet, whichever you prefer :-)... and strip back the wires on one end only

& then cable tie them together a hand apart. Crimp on the Molex sockets on this stripped end & house it to mate with the 14" previously made harness. The other end will use the red crimp on splicers to splice into the source AC in the cab.



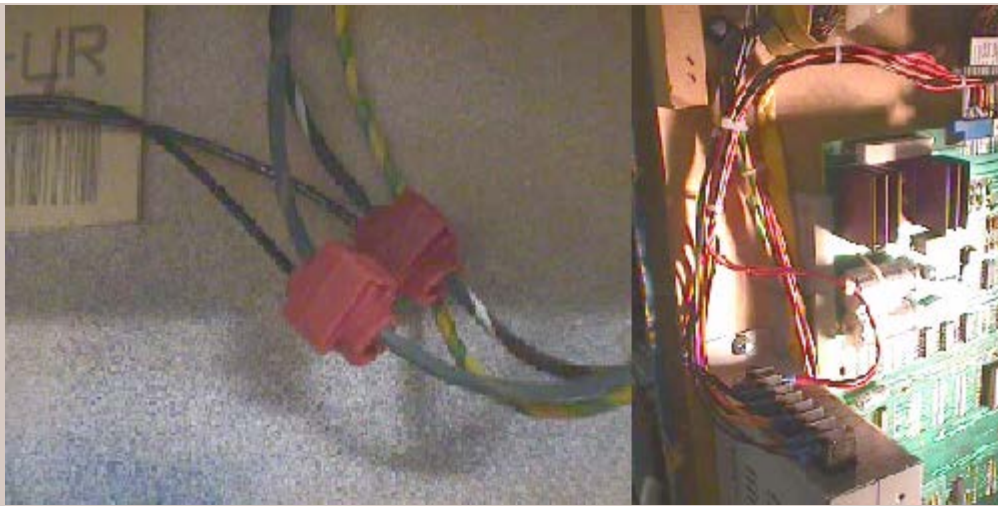
You can go ahead & install your 14" harness on the AC input terminals of the switcher to complete this portion of the adaptor assembly.

Step 7

Let's get it in the cab & power it up! I mounted it in 3 different positions in the cab & tested each to make sure there was no interference factors at play... there weren't & each position worked out well being powered from the same source... the AC feed lines that pass above the monitor & go up into the marquee area.



I tapped into the blue/gray wire & the black/white wire at about dead center over the top of the monitor as shown in the pic above. It can then go over & down through the speaker wire cable clamps on the cab side to a central area for powering the switcher.



Hey! This is a 7 step program & you're finished :-). Insert the adaptor between the main harness & the PCB, plug up your new AC feed line & see which position best suits you for fastening it to the cab. Here are several ways that I mounted it.





As I said when I launched this a year ago this past February, I just don't have the time to assemble these for sale, but the kits are ready if you are willing to do it yourself & need the parts. If you have a new decent power supply & only need the adaptor parts kit... Pacpower Adaptor Kit... it is only \$17.00 plus shipping. If all you have is a questionable old used switcher that you don't want to chance using on a classic game, than you can get a Deluxe Pacpower Adaptor Kit which comes with a new 15 amp switcher... the same as pic'd throughout here & also the one that has been working so flawlessly for everyone over the past 5 or 6 years... at only \$37 plus shipping.

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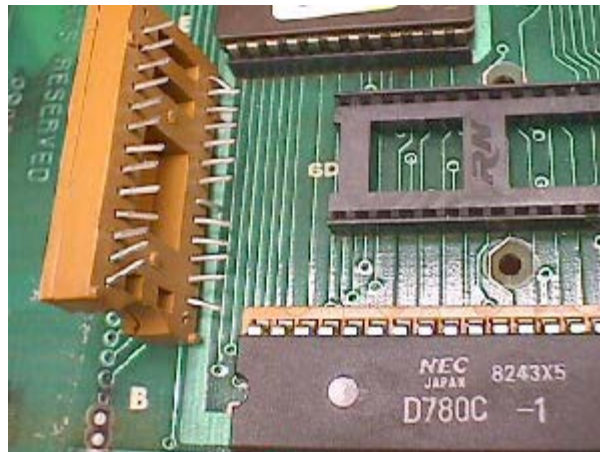
Pac/Ms Pac-Man Sockets

by Bob Roberts

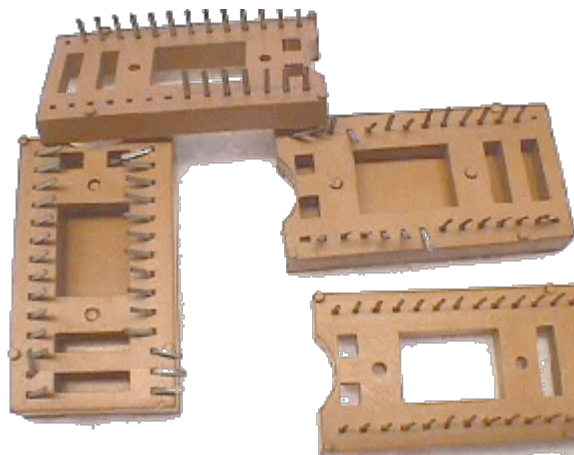
Pac-Man series of Midway Mfg Co

Here's another topic that comes up at least 3 times per week, so it's earned a place here where it may be helpful to the newbie, or at least new to owning a Pac game, and that is the intermediate sockets... brown sockets seems to be what they are commonly referred to as... that go between the Z80 Buss Sync Controller (285) & the dip socket on the main bd, and also between the V-Ram Addresser (284) & the main bd dip socket. These are installed there to raise the satellite bds up enough to clear components on the main bd.

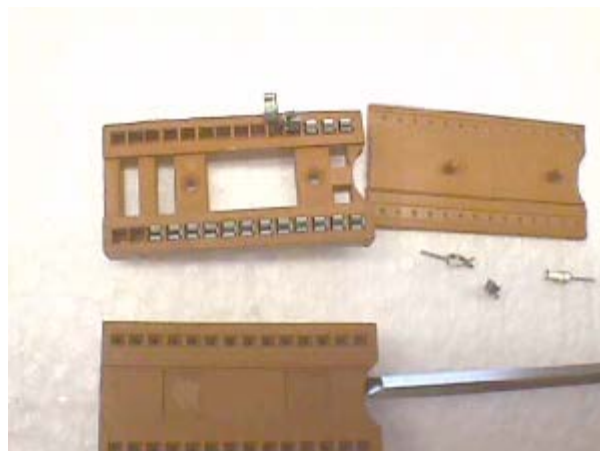
Ops use to mistakingly blame these for their Pac woes & often times they were damaged when they removed & inserted them with pins to the outside or inside of the dip sockets that they were to be plugged into.... breaking pins off more often than not :-(Sometimes just removing the sync controller to gain access to swapping the ribbon cable lead to a poor reinstallation damaging the pins of the riser sockets. My findings over the years showed that if there was actually a non-manmade problem in this area, it was the Augat dip socket on the main bd. Granted, some were ruined prematurely by the op that removed the riser socket & chucked it in the bottom of the cab, placing the satellite bd directly into the Augat spreading the single wipe pins to the point of snapping off inside of them :-(... but they were poor sockets to begin with and, unfortunately, Bally/Midway used them in lots of their bds.



Above is pic'd a typical socket plucked from a cab bottom grave where it was left as dead. I personally like these riser sockets & always rescued them from their premature resting places. The pic below is of what most would consider junk to be thrown out, but what I see is 3 definitely good sockets & the potential to save another five sockets from oblivion!



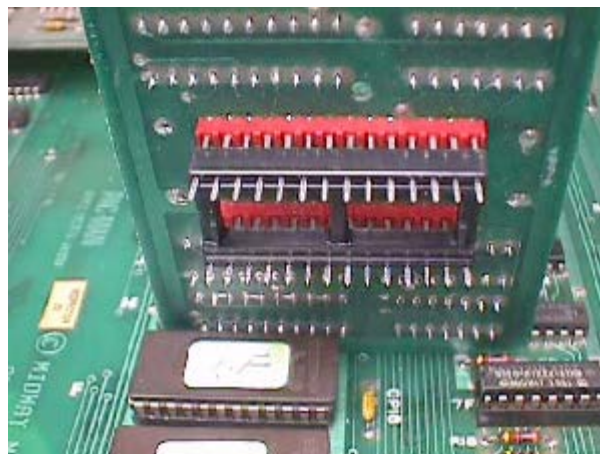
How is this possible? Well... it's pretty easy since these sockets were made in such a way as to allow you to change single pins in them. Take a look at the socket below with the cover gently pried off the top exposing the pins. You can see that they can be gently pushed up from the bottom & removed to be transplanted to become the missing pin on your existing socket. Take notice of the sculptured face of the pin & reinsert it into it's new home facing in the same direction as the others.



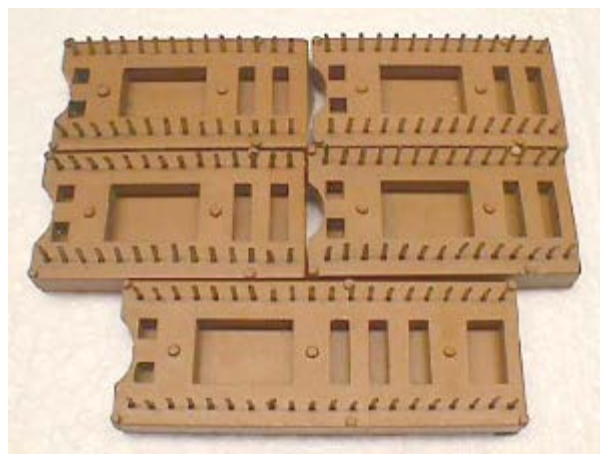
If you find yourself in a position where one of your sockets has a broken pin & you don't have a replacement pin, or an old socket to remove one from, then I would recommend keeping the good one in place & replacing the cripple with a standard dip socket, keeping the cripple for future use or repair. If the main dip socket has had the wire wrap posts of the sat bd plugged into it you'll have to replace it, as well. Two standard 28 pin dip sockets is an inexpensive repair that can be changed out in the future with no trouble.



These sockets will stack up readily, but you still need to take caution when inserting them into each other. It doesn't take any more time to keep an eye on the pins, making sure to guide them into the proper positions, than it does to insert them sloppily... which usually results in you redoing the work, anyway :-(



Once you have in place & have tested the board it's time to strap them down. There are holes on either side of the sat bd socket & main bd socket that align to allow you to use a cable tie to strap them in securely. I've found that it is easier to use two 4" cable ties... feeding one up through from the bottom & one down through enabling you to join the two on both the top & the bottom allowing a greater range of movement & a tighter hold.



I still like these best & wish they were still available today. Well.. I hope this helps somebody get their Pac bd back on it's feet again. HmMMM... Pac with feet :-)

Happy Gaming.....

All the help you will need with Pac games
can be found here:



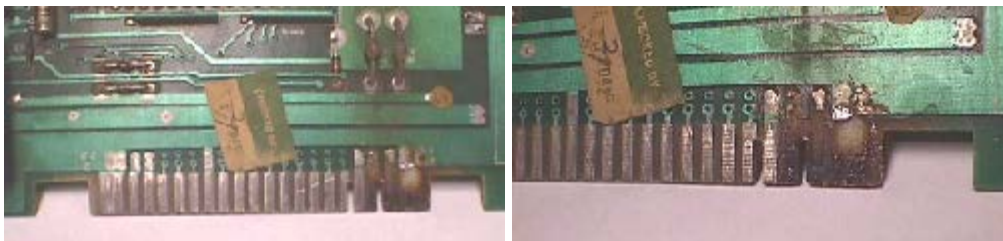
Many Pac-Man parts can be found on the [Parts Page](#)

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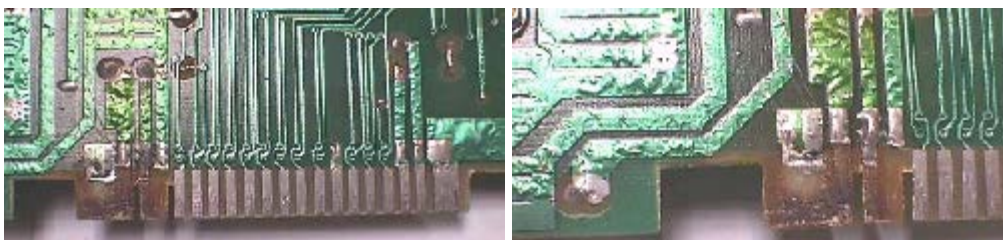
One Way To Repair Your PCB Edge

by Bob Roberts

There seems to be a lot of PCBs today that have the edge pads burnt right off. Pac boards seem to be the most vulnerable due to the less than adequate edge connectors that were utilized in the cabs, but there are many others, as well. I'm asked frequently how I repaired them over the years & of all the ways that I accomplished this repair, I believe this one to be the ugliest, but yet the best as far as longevity goes. I used less invasive methods whenever possible, but when you have something at least as bad as the one pic'd below, it is somewhat of a necessity.



As you can see, the pads on the parts side of the board at power entry points are pretty much disintegrated :-(This is the board that you will sometimes see an op's handy work on. I'm sure you have seen them jumpered with something like lamp cord soldered directly to the board & spliced into the harness... or worse :-(I suppose it was better than file 13, and perhaps my method isn't much better, but it is easy to maintain & is still plug n play.



The solder side of the board didn't fair any better than the parts side. I've seen them before with this little corner completely burnt off & some that were so charred that someone had cut them off with a saw.

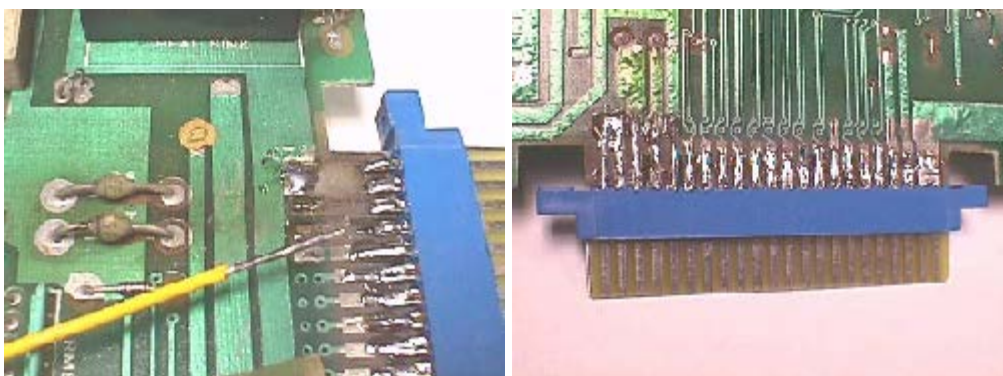


The first thing to do is to get as much of the carbon residue off the board as possible & I normally use a Scotbrite pad for this. Depending on how corroded the rest of the pads are, I either use the Scotbrite gently to bring back the shine or an eraser if they are in decent shape. If an eraser is used you should make sure your eraser residue falls away from the board. Many times I've seen socketed chips that were assumed bad actually being the victims of this non-conducting residue! An air compressor will usually remove any loose debris, but sometimes forces it into a

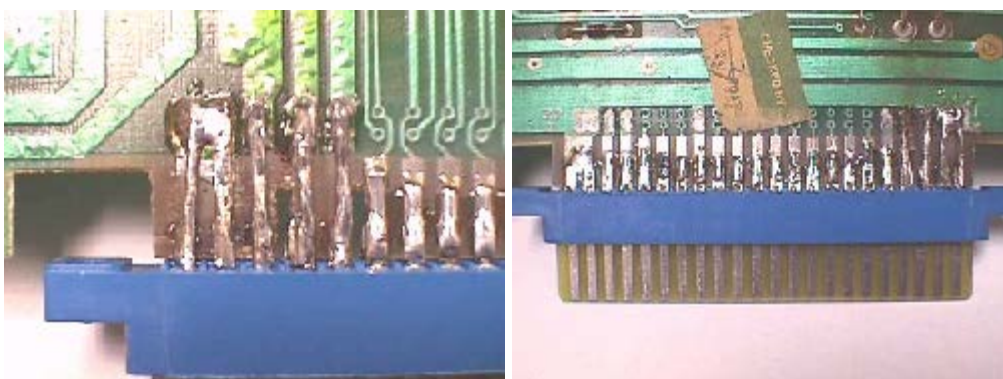
crevice where you really didn't want it. K... all cleaned up & ready to move on.



Time to slip a 22/44 solder eyelet connector over the pads in much the same way as making adaptor bds. The type 3 fingerboard in the connector is going to become your new edge... a replaceable one in the future, if need be. Tack it in place, check to see if it is perpendicular & then finish soldering it to all the pads that are still there.



Now it's time to bridge those gaps where the pads are missing. Take a piece of 18ga wire & tin about 3/4" of it, solder the end to the connector SE & then lay it down onto the remains of the old pad, solder & clip off the wire. Repeat for each missing pad.



Like I said, it's ugly, but it is a permanent way to save a badly damaged board.

This connector/fingerbd combo is available on the Parts Page:
PCB Edge Repair Kit 22/44 \$8.00

Happy Gaming...

Pole Position To Pole Position II

by Bob Roberts

Let me preface this by saying that it has been 20+ years since I did this & everything here is from a few notes I took, my checksum cards, a couple old board sets & my memory... which I'm sure is not even close to what it use to be... so this may be full of errors, but I thought I should record what I could before it is all just a blur :-)

Back in the days, when Pole Position was prevalent on the streets, ops were quick to spend a few hundred dollars on an upgrade to Pole Position II to enhance their collections.... income, not games :-) Once the rage died down for Pole 2 it was not a practical conversion to make because it was a labor intensive job involving many components, lots of desoldering & soldering, as well as, adding sockets & programming eproms.

Jumping ahead to about 7 years ago, when eprom programmers came down in price & used ones were easy to find on eBay, hobbyists began asking about this conversion. It didn't matter if it took 8 hours, 16 hours or whatever... it was a weekend hobby that didn't put food on the table. I've been reluctant to aid in this because I think it is a job that requires more skill than a novice hobbyist has acquired & could easily result in the death of a classic board or one with many Band-Aids, at the least, but it seems that many have gone ahead & successfully made the conversion, so whatever input I place here can't hurt & maybe will help. The one thing that was a stumbling block was the custom chip needed at position 4K on the CPU bd, so I have aided in providing a replacement that we used back in the day, but other then that everyone seems to have the prom & eprom programming info & able to pull off the conversion with little to no trouble. Perhaps hobbyist are a little more proficient these days.

What Does It Involve?

CPU Board:

- Programming 10 eproms
- Adding 3 sockets (Most boards - some had sockets already)
- Installing custom chip

Video Board:

- Programming 10 eproms
- Programming 7 proms
- Adding 4 eprom sockets
- Adding 7 prom sockets

CPU Eproms To Change/Add

Position	Chip Type	Checksum
3D	2764	\$83FE
4D	2764	\$F9FE
3E	2764	\$63FF
4E	2764	\$4DFF
3L	2764	\$420B

4L	2764	\$19AE
7H	2764	\$51FF
7F	2732	\$7BFF
12E	2764	\$5D50
12F	2764	\$5D50

- You may need to add 28 pin sockets at 4E & 4D
- You may need to add a 24 pin socket at 4K or leave 28 pin if installed
- Install custom chip at 4K - see note below

Video Eproms To Change/Add

Position	Chip Type	Checksum
6N	2764	\$BE3F
7N	2764	\$DF95
12K	2764	\$CC2C
13K	2764	\$E617
12L	2764	\$96A7
13L	2764	\$9F2B
12M	2764	\$AA17
13M	2732	\$469F
12N	2764	\$43CF
13N	2764	\$E2A3

- Remove 24 pin sockets at 6N & 7N
- Install 28 pin sockets at 6N & 7N
- Add 28 pin sockets at 12M & 13M

Video Proms To Change/Add

Position	Chip Type	Checksum
4L	82S137	\$0CF4
5K	82S129	\$07D4
8M	82S129	\$02B3
11C	82S129	\$034B
11D	82S129	\$03B5
11E	82S129	\$03C9
12H	82S137	\$1736

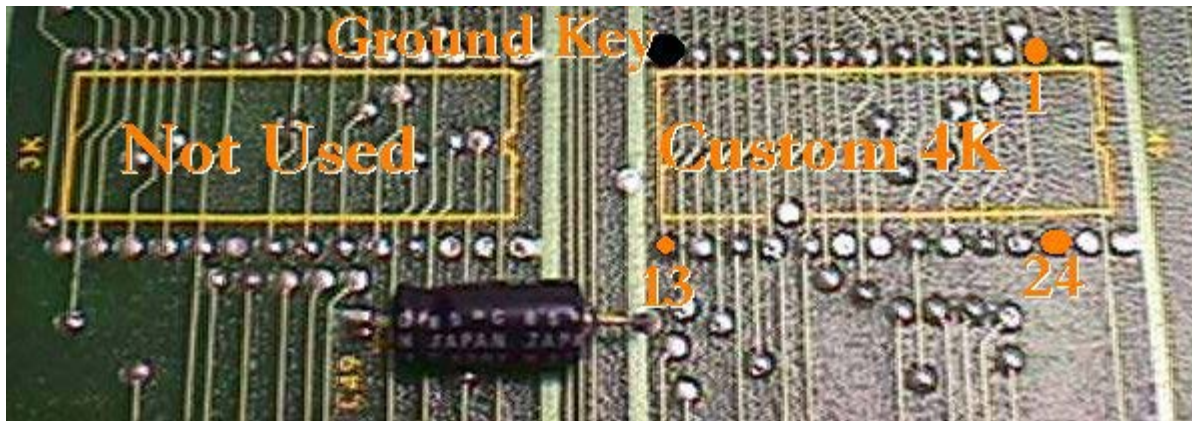
- Remove soldered in proms listed above
- Install 16 pin sockets at 5K - 8M - 11C - 11D - 11E
- Install 18 pin sockets at 4L - 12H

Notes

- First run CPU boards A039185-21 "D"
- Later run CPU boards A039185-22 "E"
- First run video boards A039187
- Later run video boards A039187-21 "B"
- Watch your notch direction when installing chips

Take care in desoldering/soldering

- If CPU 4K is 28 pin socket key to ground pin (1,2,.27,28 unused)



Happy Gaming...

Possible Pot Replacements

G07 B+ Pot

The G07 B+ pot is an oddball size that is no longer available, so here are a few of the pots that I have in stock that could be made to work in place of them with a little bit of work & bridging.



This is P1017 from the [Pot Page](#)... a vertical mount 2.5K. The 2 outside legs can be bent slightly to fit the footprint on the PCB, while the center tap can be bent to a 90 degree angle allowing a jumper to solder to it & the thru hole in the PCB. Using a paper clip adds stability to this bridge. Using a ScotchBrite pad to remove the paper clip's coating allows for a better solder joint that will hold up to much abuse.

The other 4 pots in front of the B+ pot in the pic above are sold in a kit or you can order individuals by number below.



Below are a few other G07 B+ pot replacement possibilities.



This is P1065 from the [Pot Page](#)... a horizontal mount 2K. The outside legs pretty much fit the footprint & bending the center tap to a 90 degree allows for a bridge to the PCB thru hole.



This is P1048 from the [Pot Page](#)... a horizontal mount 2K. It fits pretty much the same way as the P1065 above.



This is P1062 from the [Pot Page](#)... a horizontal mount 2.5K. Like the 2 above it drops in at the back, but needs a bridge to the center tap.

For the skillful person it would appear that a precisely hand drilled hole would be possible making the center tap drop into place like the other 2 legs & make contact with the correct trace on the bottom side of the PCB eliminating the need for a bridge.

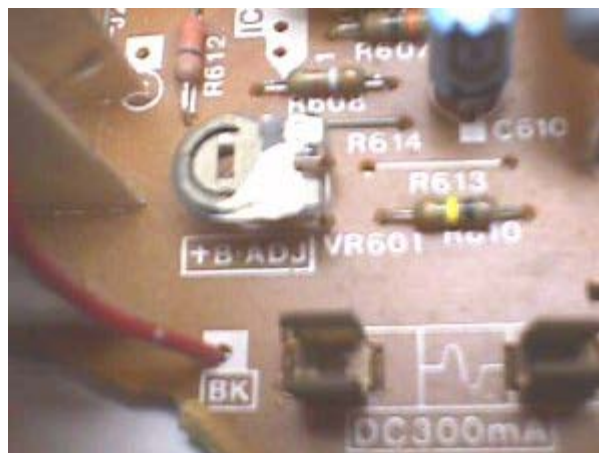
The best alignment tool kit that will do all these & more is this one from my Tool Page:

Bob's Plastic Alignment Tool Kit (horiz width coils) \$4.00



Sanyo 20EZ B+ Pot

Here's one that James Hagen brought to my attention.



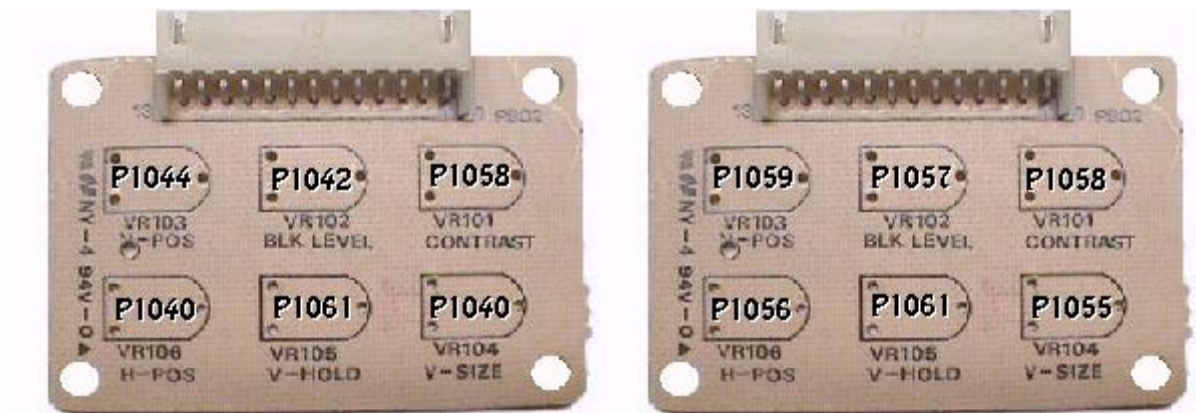
Pot P1066 from the [Pot Page](#)... a horizontal mount 5K... is a drop in replacement for this one.



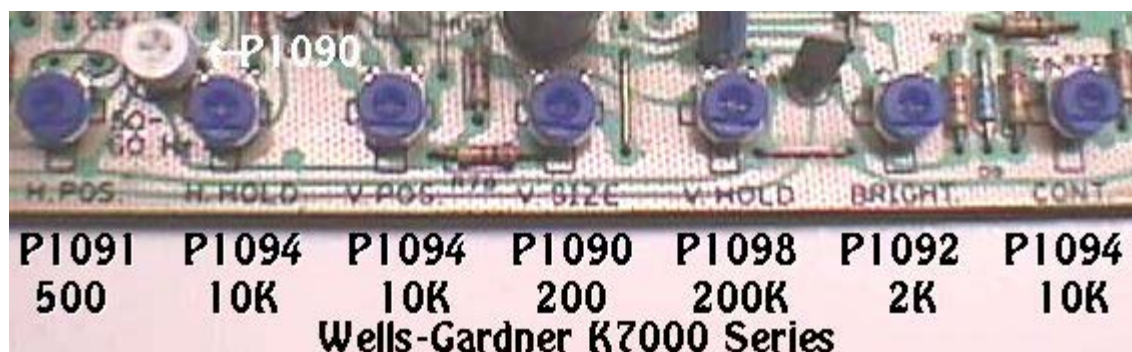
There is a kit for the above Sanyo remote board on the Parts Page, but the pic shows all the same style above & a few have been exhausted & hence replaced by the pot numbers above them in the pic if you're looking for a single pot.

K7000 Pots

I'm fast running out of the horizontal replacement pots P1039 thru P1046 for the K7000 series remote pot boards & as soon as each value is gone it will be replaced by P1055 thru P1051 style pots. Both pot types can be used conveniently as can many of the other "C" types on the Pot

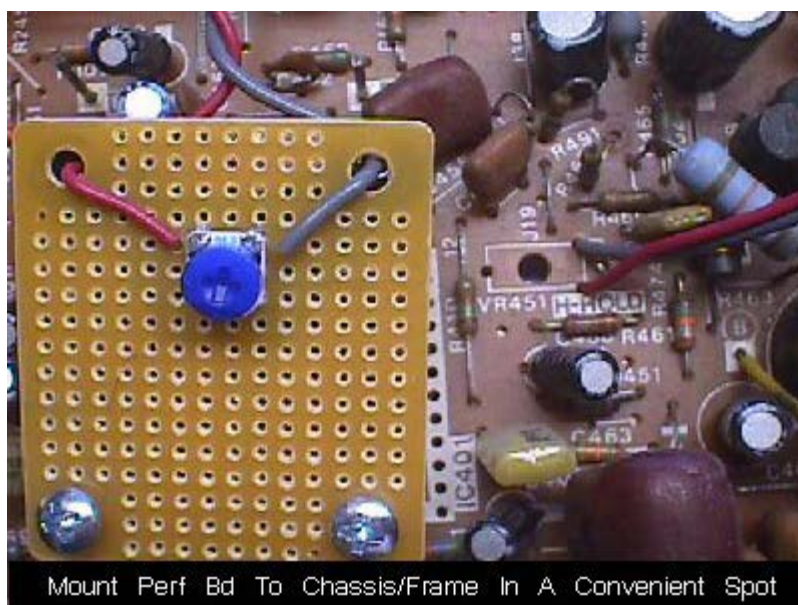
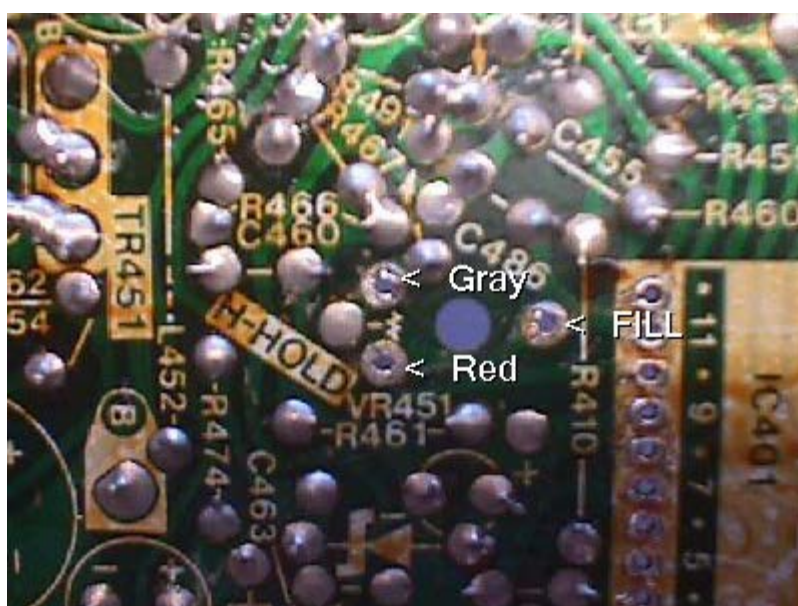
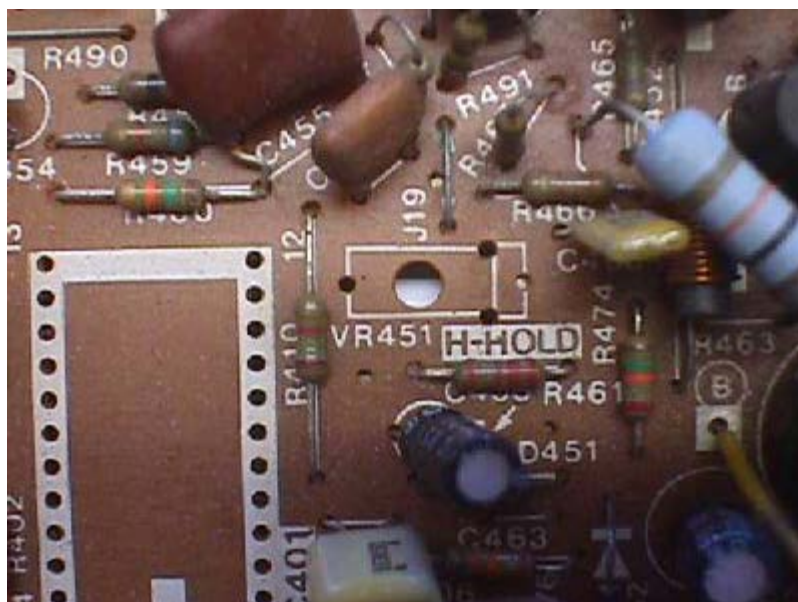


The discontinued vertical pots P1138 thru P1142 mounted directly on the chassis of some K7000 models are disappearing even faster. Those pots were mirror images of most others that were used, so they are a little harder to replace. Using the standard pots faces the knob inward & there really isn't enough room to do that because of other mounted components. The best way to replace those is to go to the horizontal mounted "E" type pots.



Sanyo 20EZ H-Hold Pot

This long since obsolete, side mount pot with the odd value can be replaced with a remote mounted pot. Our harness maker made up a few of these & they seem to be working out well. For now we have managed to keep them at \$5 each. The kit consists of a pot mounted to a perf board with 14" of wire attached & 2 mounting screws.



K7000 Neck Board Pots



[Click Here For More Details](#)

[CTS Trimmer Pot Color Code](#)

Happy Gaming.....

[Parts Page](#) | [Site Index](#)

Testing Your Power Supply

With Another Game?

--

By Bob Roberts

Over the years I've read hundreds of emails about using another game in your collection to locate a problem you have with your favorite game. Many do this the hard way & I've already written about using [monitor extensions](#) because so many were telling me how they pulled the monitor from one to put in another just to eliminate it as the problem child :-(Obviously, going to all that work can also be detrimental to both the monitor & yourself, should it be accidentally bumped or dropped during this process, hence, the article on using an extension.

Another very common thread in emails is the transferring of the power supply board and/or transformer assembly between games from the same manufacturer. A typical scenario includes the above mentioned monitor and starts out something like this....

I have a Stargate that has squiggly lines [insert your symptom here] on the screen & I've taken the monitor out of my Robotron & tried it in the Stargate with the same results. I swapped out the power supply board & still had the same results :-(Can I transfer the wiring harness & transformer between the games?

Another example would be... I have a Stargate with a light bar scrolling through the pic & I don't think it's the power supply because I measure 5 volts with my meter & I know it's not the monitor because I swapped in a good spare & it made no difference. In case it is the power supply can I make my Galaga power supply work in the cabinet?

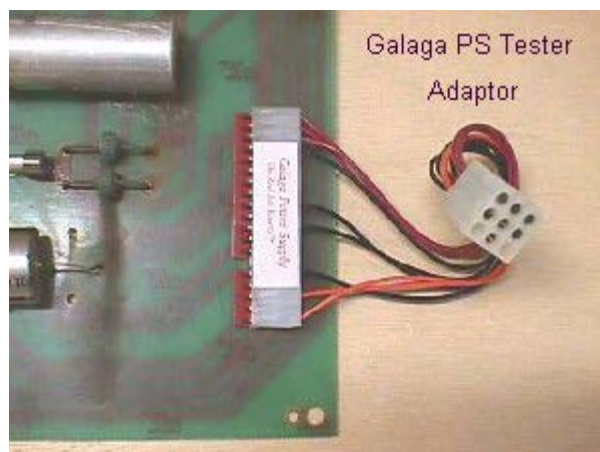
There are many varieties of this Q including the simplest one of how can I be sure I'm getting clean power to my Stargate because I have a ripple coming from somewhere. Well... you can use one of your other game's DC power source to rule out power supply problems, but this is a task no matter how you do it, so the easier way is to test the power supply that is in question. I've explained how to do this in email many times by using an old JAMMA harness that you may have laying around, perhaps from one you needed to change out. For those who did not, I made up harnesses for them. Back in February I made one of these harnesses for a collector & shortly after he received it he ordered 2 more for fellow collectors who had seen his & asked why I didn't have it on the Parts Page... encouraging me to add it, but I didn't want to until I had the time to write it up in more detail. Soooo.... Here's how you can do it!

All you really need to see is that the 5 volts is clean enough to drive a PCB. Minus 5 volts & 12 volts are usually used for biasing audio circuits, so they are not really needed when testing. There are so many cheap JAMMA boards floating around these days that you can easily find one to be your test board. The basic requirements for testing purposes are power to drive the board & video to enable you to see the results, hence an old replaced JAMMA harness since I/O lines are not needed & are usually the cause for the replacement. I don't have any old JAMMA harnesses kicking around to use for this, so I'll walk through the harness portion with a new one & if you have an old one you can see what needs to be remove from it.



As I said, basic power & video bundles are all you need & with a standard 5' harness using separate bundles you will have approximately a 10' reach between games. Of course, you can connect back to the same game monitor to eliminate wiring, break connectors & PCB as suspect. If you're starting out with a used JAMMA harness you can remove any I/O lines that are not necessary making this much easier to handle & store. For the video termination if you use a 4 position & a 2 position Molex .156 housing you'll be able to mate up to just about any monitor's header. As you know from the [Monitor Extension Page](#) there are a few exceptions, but chances are you'll always have a suitable monitor & by using the 2 & 4 position connectors you can adapt to any situation. For example, the 2 connectors will fit side-by-side for a +sync connection such as the Stargate & other WMs games of that era. With the looped sync connection in the 2 position connector you can easily hook up to a separate header with -sync input such as the G07 monitor uses. To go a step further, when hooking up sync to a K7000 chassis where only the HSYNC is used for composite sync, the 2 position can hang out over P6 of the header into the keyway to supply the single composite +sync connection, or it can hang out over the 10th position of the header for composite -sync.

In power handling you'll want a base break connector to work from for different power supply hookups. This allows rerouting lines to their correct positions, so that you don't need a harness for every type PS you want to test. I've always used the Molex .093 housing... the 3x3 in the pic of my harness above... since the first PC-type supply was introduced to the arcade game. The reason is simply because the mfrs followed an assigned pinout & this allows for the test harness to plug into any PC-type power supply directly & unadapted. This type PS is easy to use outside of a game cab, as well, because of the 2 simple connections to AC in & DC out. Any PS you want to test can easily adapt to the PC-type 3x3 connector.

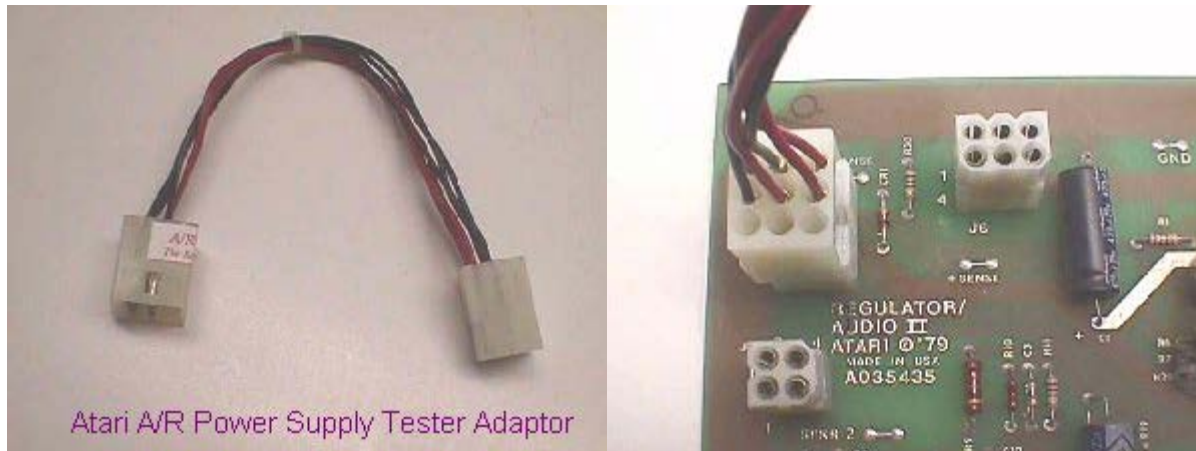


The adaptor above will utilize the Galaga's linear power supply to the test harness' 3x3 DC power input. By using this power to drive your JAMMA test PCB & feeding the video to a

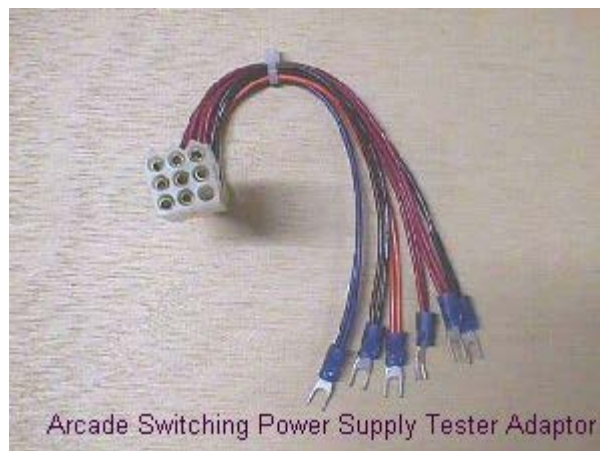
known good monitor, whether in another of your games or just a spare monitor sitting out of a cab, you'll be able to see whether, or not, the DC power is clean. If you get the same crappy looking pic when hooked up this way, you've proven out that the Galaga's PS is the fault.



This adaptor is for the Williams linear power supplies & serves the same purpose, as does each type of PS adaptor, simple rerouting of power lines to their appropriate destinations.



This adaptor allows you to connect up to Atari A/R boards.



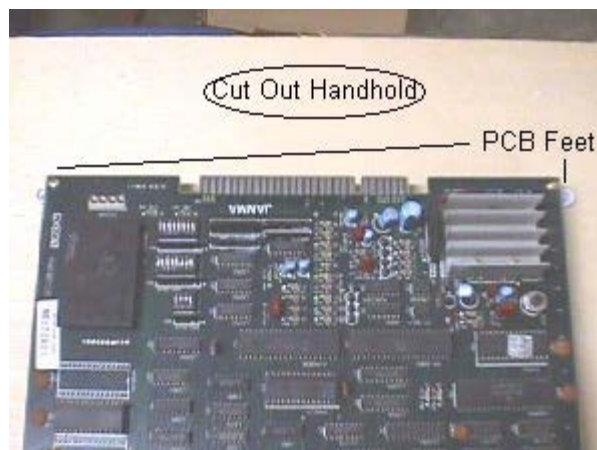
This adaptor allows you to connect up to a standard arcade switching power supply.



Now that you have a harness all that remains is to select a JAMMA PCB to use for a test board. I always liked the older Konami boards for this because of their built-in generator supplying all the testing aids needed.



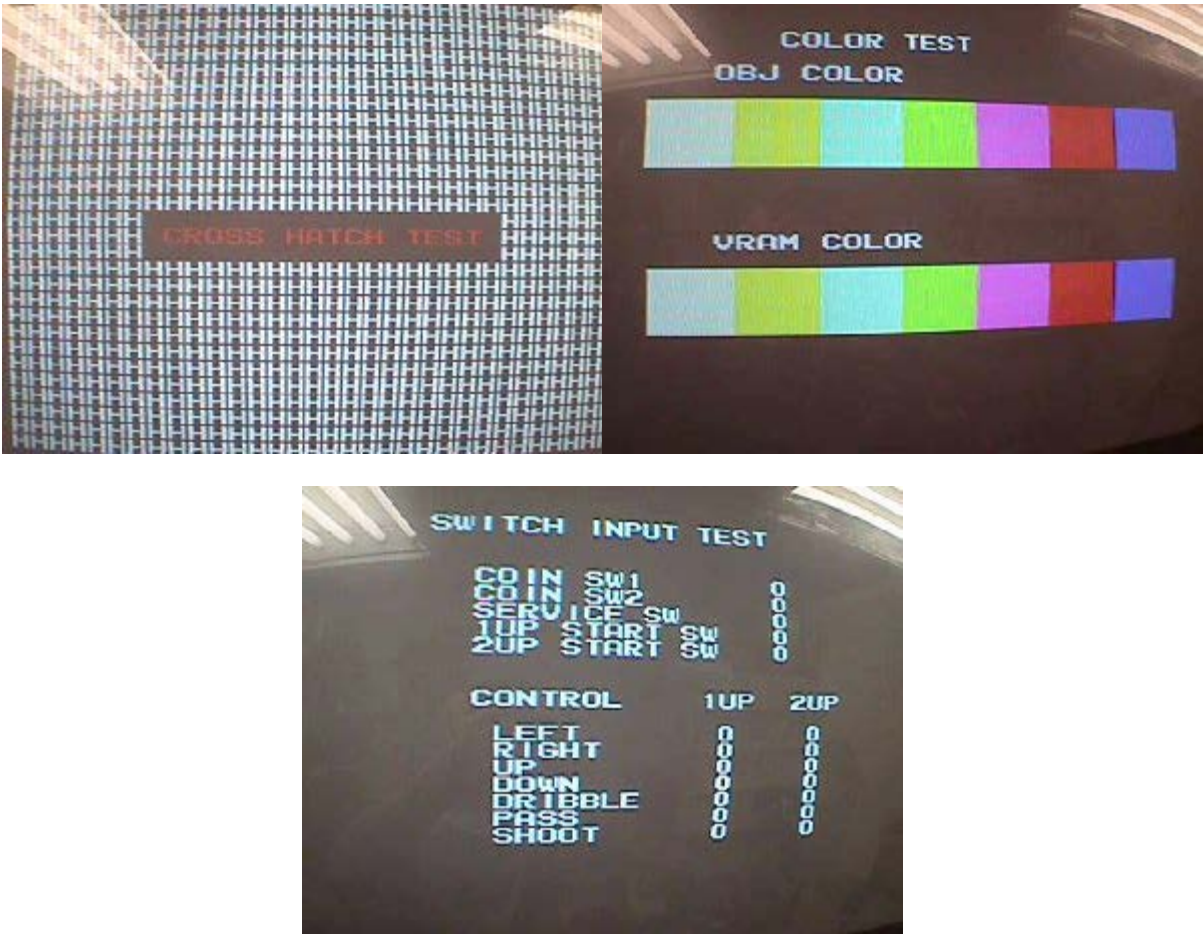
If you color in the 2 dip switches that control normal operation or test mode it'll be easy for you to swap between the two modes.



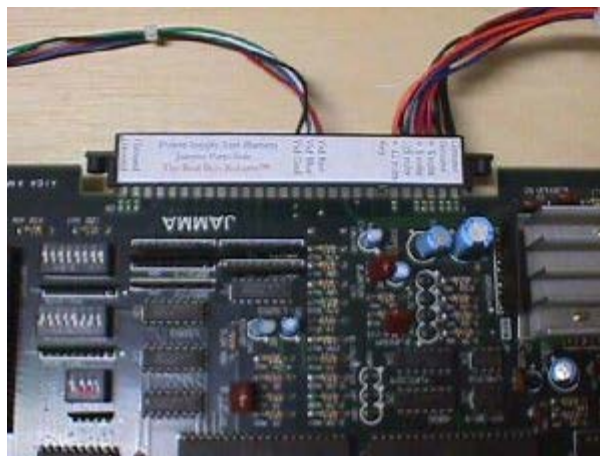
If you're one who spends as little as possible on a testing aid, saving every extra penny for that new game you've been wanting, you can simply cut a piece of cardboard the size of the PCB & cable tie it to the solder side to protect the PCB from shorting to anything when handling it. If this isn't for you, you can always mount the PCB on a piece of plywood & even cut out a handhold to tote it around by.



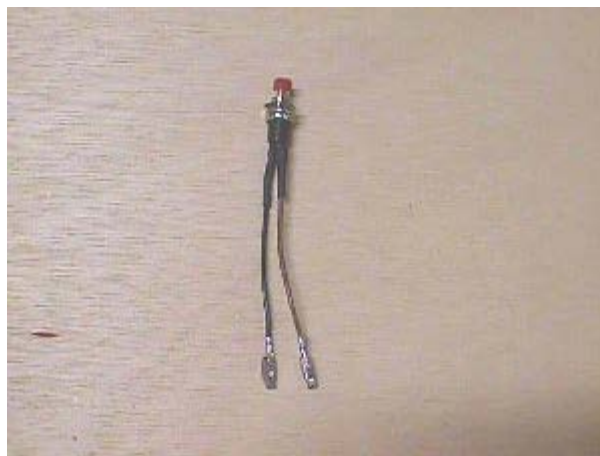
Mounting the PCB with PCB feet makes for a much neater looking project.



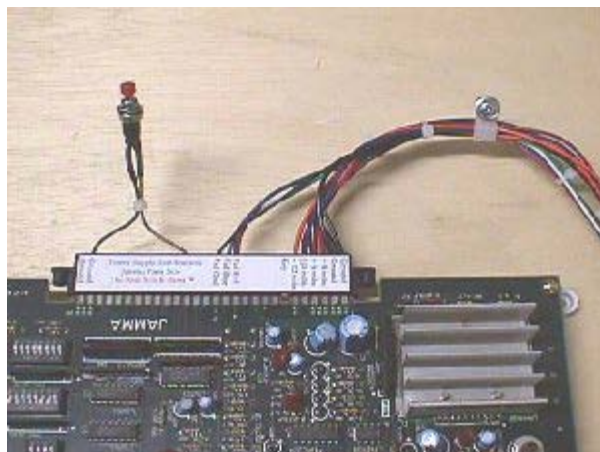
These are test screens available on the Konami PCBs.



The pic above shows the basic harness connected to the Konami PCB, but in order to change test screens you'll need to add an I/O line to 1P start, since it is the advance switch in test mode.



The easiest way to add the switch is by using a small momentary switch such as the one above.

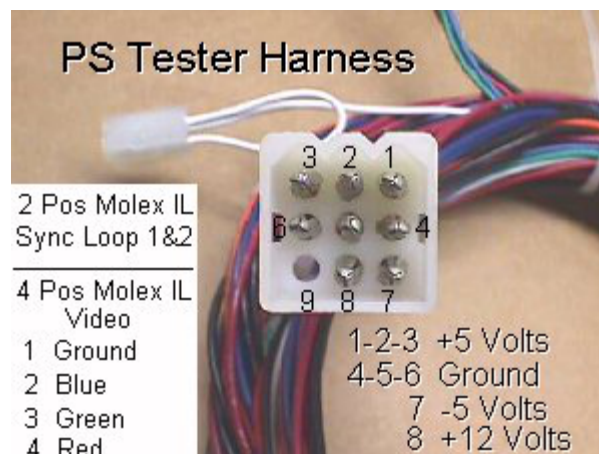


Just slip one lead into a ground position on the JAMMA connector & the other one into the 1P start position. You can add a switch this way if you use another PCB that may have test screens by simply placing it in the correct I/O line, i.e., if "test" or "service" control these features on your PCB, just pin it to the appropriate position on the JAMMA edge connector.

The pic above shows both bundles leaving the right side of the tote board thru a cable clamp... this is just to highlight the added I/O switch & you should use a cable clamp

either side with bundles separated for maximum mobility.

The only other thing I can think of that may help you build your own is putting the basic pinouts here to save you from looking them up.



If you are one of those that rather have it ready made you'll find it on the [Parts Page here](#).

Happy Gaming...

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QUICK & EASY VIDEO T-SHOOTER

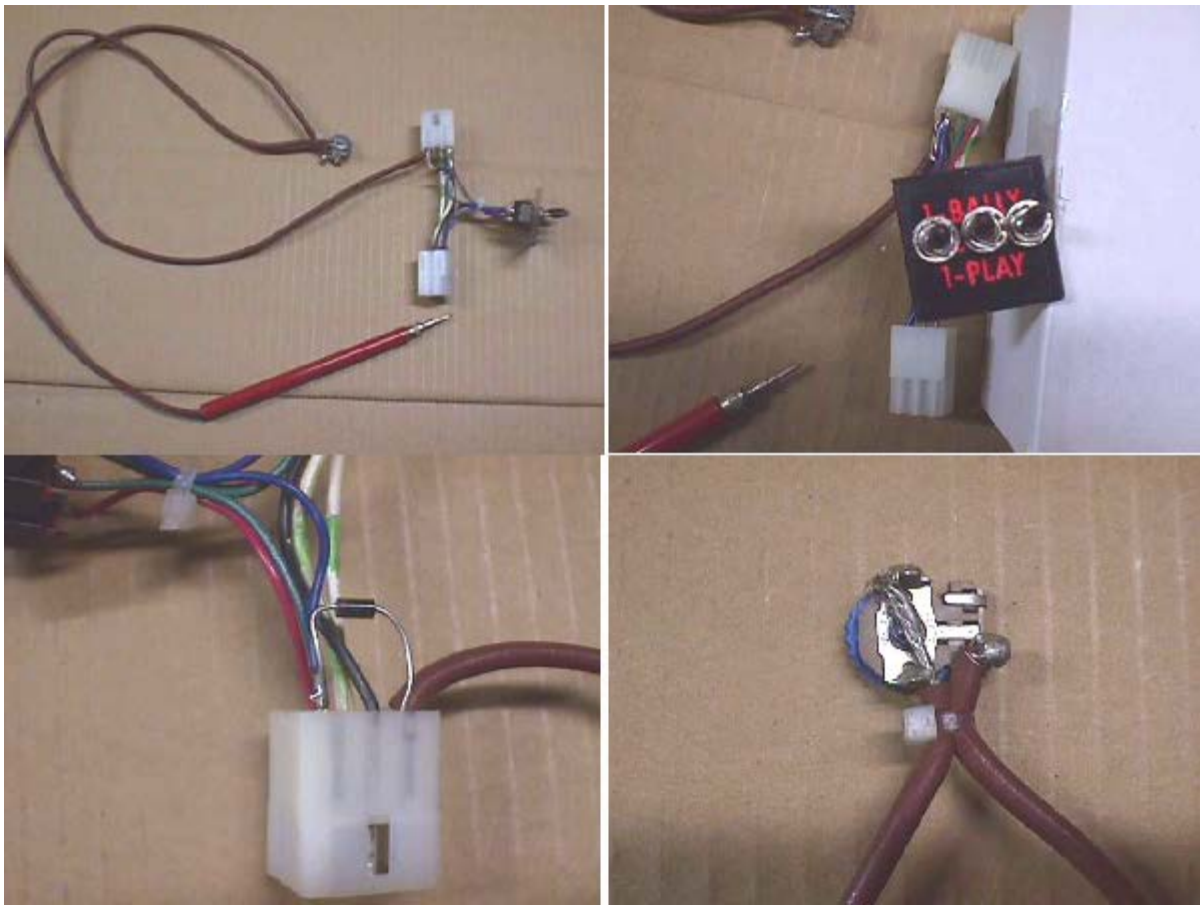
by Bob Roberts

For quick video t-shooting in the shop, I use this simple to build device which can aid in checking a variety of components on the pc board right on your work bench. The one I have is made up on a 9-pin Molex plug because all my jigs are made compatible with these for quick coupling of any device. You can make it up using a Molex in-line header & housing, enabling you to insert it in line with a video game monitor right in the cabinet, if you so desire.

The basics of this device are that you can control the video on the screen. You can turn any or all colors off going to the CRT. The first step is to interrupt the video feed lines... R-G-B...by making an interrupt cable of your choosing, to insert in line. You can get as elaborate or as simple as you want.

An elaborate one would be in a case with the connectors mounted, as well as, the cutoff switches and even a banana jack to insert the probe, with the adjustment pot also mounted in the case.

My simple design is quickest to build & use and is based on free-hanging the components. I used an old coin window plexi...because it was handy...& mounted the 3 mini-switches on it. Next I got a Molex 9-position plug & receptacle and ran the sync & ground straight through and the R-G-B signals were run to the in/out terminals of the mini-switches. At this point, I am able to turn any of the 3 video signals on or off.



Now, how to use this to T-shoot? I took a test lead, & since I wanted this free hanging, I cut it about a foot from the probe & inserted a 5k ohm thumbwheel pot. Now I am able to adjust the input from the probe by changing the resistance in the input line. Next, this input has to be fed somewhere. In my Molex 9-position, I am only using 6 of the positions,

so I opted to connect a blocking diode in line, by pinning the anode & the input lead together & inserting them into a dummy position for added strength. The cathode of the diode was then pinned to the blue input....cause I like blue...for an input that could be seen on the CRT.

Ready to work! Once you have this in line to your test monitor, you can cut off the RGB inputs and the screen will go blank. At this point, any feed from the probe will show up directly on the monitor. For instance, if you probe the outputs of a 74LS161...11/12/13/14...you should see a pattern and it should step up with each pin of the output. If you hit on the 5 volts, your screen color will turn on. If you hit on ground, nothing will happen. You can turn on the R &/or G video feeds while probing, as well, if it helps you to compare. After using this method of T-shooting, you will become familiar with different patterns, and know right away when something is amiss.

Happy Gaming.....

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Reading Trimmer Pots

by Bob Roberts

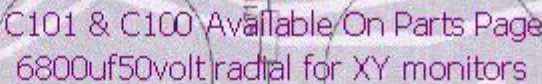
I mention this several other places, but I think it's time to give it a brief page of it's own. "How do I know what value my pot is? ", is the Q most often asked. Short of pulling it from the circuit & measuring it with a meter, the numbers on it can be read with ease....

Pots can be read by taking the first two numbers and adding the third number as the amount of zeros after it, e.g., 103 would be 10 with 3 zeros after it or 10,000 ohms which when shortened to the Greek abbreviation K for kilo which translates to 1,000, would be 10Kohms.

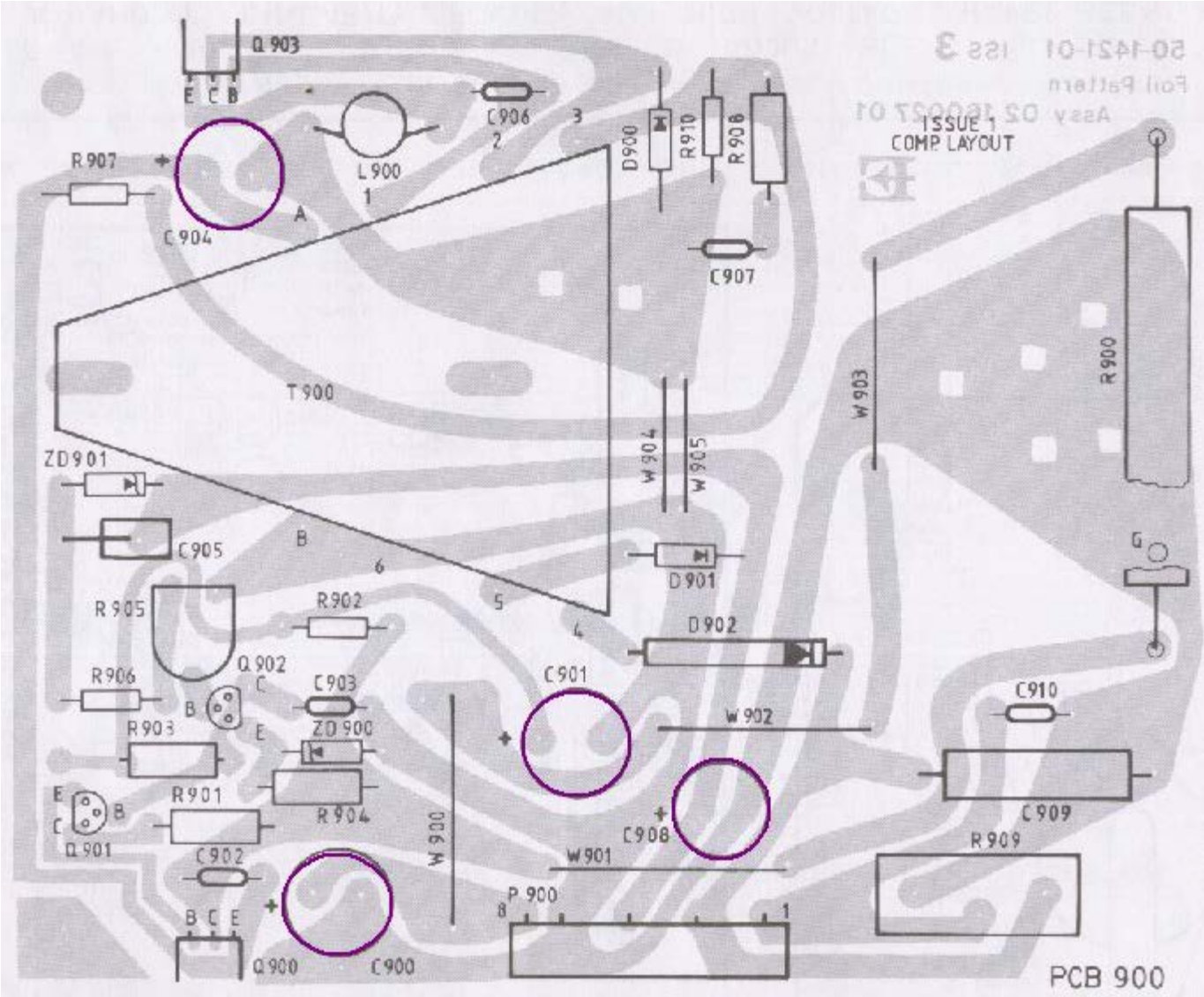
Hence, 201 would be 200 ohms & 202 would be 2000 or 2Kohms. Now, with the advent of much smaller parts with less room for stamping these numbers, they've shortened this same system, so that now you may find numbers like "23" representing 2Kohms... 2 & three zeros or 2000 ohms. A pot value of 200,000 ohms, 200Kohms, would be expressed as "25", 2 with 00000 for 200,000 ohms.

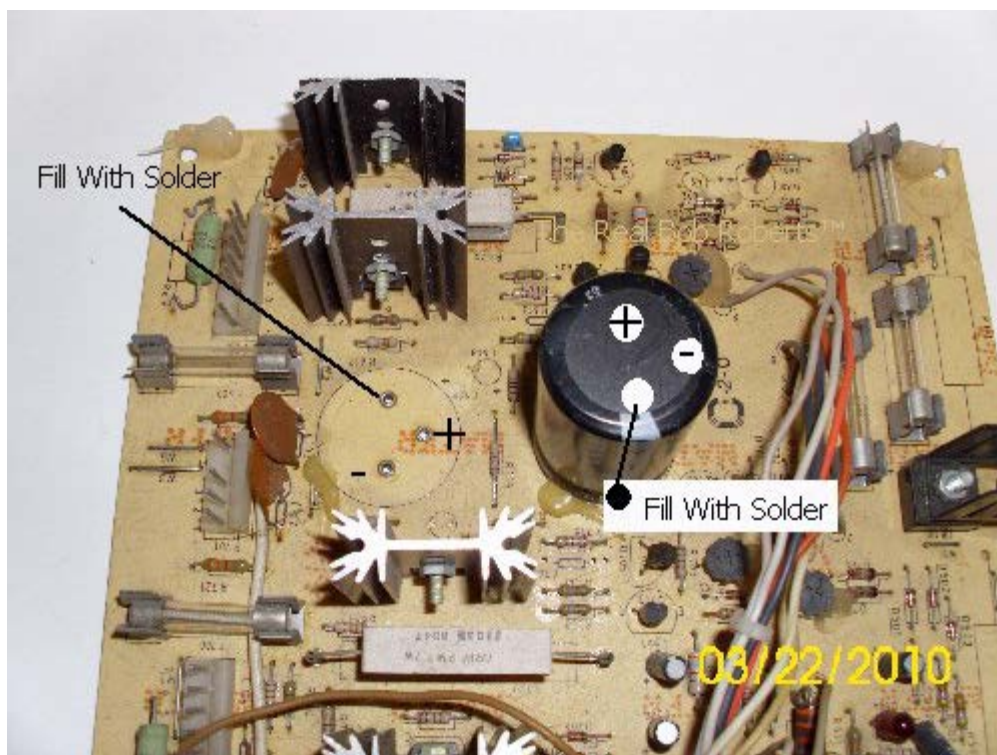
In short, your pot may have the value written out, 200K ohms, "204", "25" or perhaps nothing at all in which case you would have to remove it from the circuit & measure it with a meter to the 2 outside legs. The reason for this removal is to get an accurate reading of the pot since in-circuit it may parallel other components or have the center tap shorted to one of the 2 outside legs. If the pot in Q is mounted on a remote board that is disconnected from the rest of the circuit, but you can see it has one leg shorted to an outside leg, it is possible to get a rough reading in-circuit by rotating the pot from it's max to min, or vice versa, while reading with the meter. Depending on how it is mounted your reading will vary from zero to the rough value at the other extreme.

Happy Gaming...



See Pics Below On Replacing C100 & C101

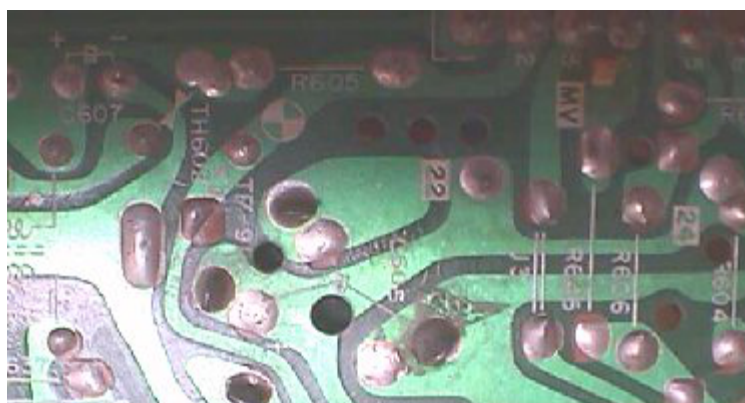




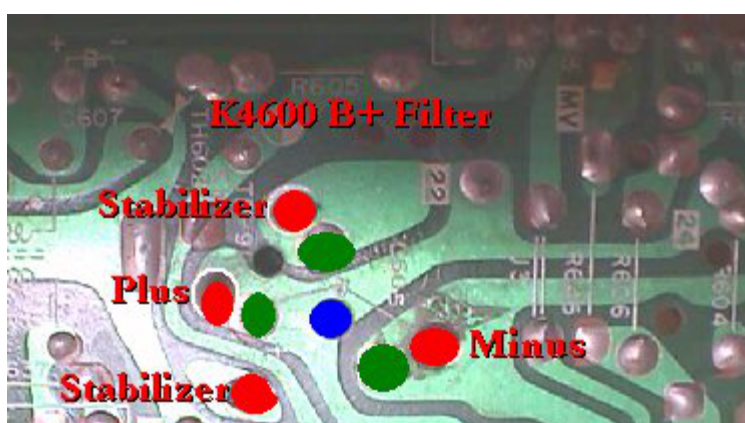


Replacing The K4600 B+ Filter

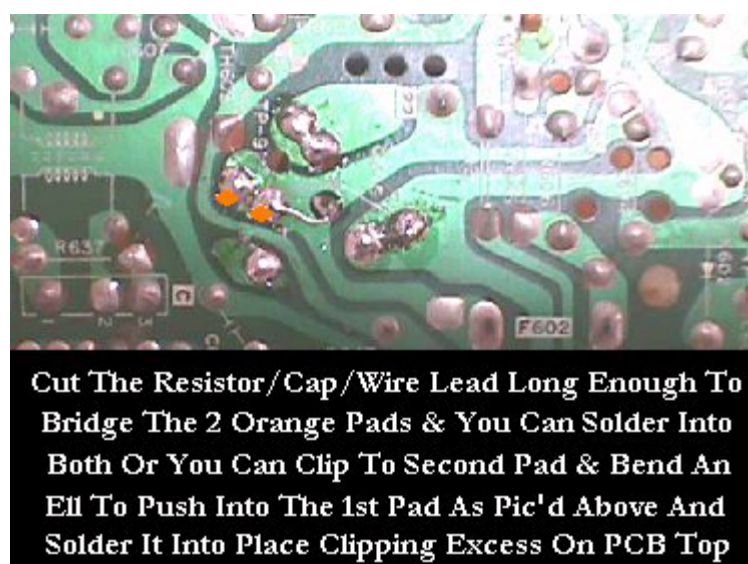
By Bob Roberts



Replacing The Retired Large B+ Filter Cap
On The K4600 With A Modern Type Filter
Much Smaller In Size So No Stabilizers



The Green Points Can Be Used For Other Sizes
As Well As The Stabilizer Holes & Blue Dot
Tying Into The Plus & Minus Pads Is The Goal






Happy Gaming...

Calculate Resistor Values from Color Codes

Black Black Black Gold

Resistance Value:	
	

SafeBack Dischargers

by Bob Roberts

Way back in 1998 lots of newbies to the video arcade collecting hobby were still getting minor shocks from discharging CRTs (picture tubes), and moreover, were simply stating that they were scared to death to go near the monitor, or particularly afraid of the high voltage anode lead & the discharging of it to remove the chassis. In fact, some reported some horror stories of their attempts to simply wind a piece of wire around a screwdriver and discharge a monitor as written up here in **netland** someplace. This may be alright for an experienced person to do... although I would never do anything like it or recommend it to anyone... but a newbie most times has no knowledge of electricity [or very little] and sometimes does not follow the instructions as closely as needed to perform a discharge in this manner safely.

I finally came to the conclusion that newbies were going to persist in trying to discharge a CRT in this manner even after being bitten once... and even twice or more in some cases... (Mr Macho - I can take it!)so I decided to do something about it before someone was really hurt, or worse, residing in a new home much earlier than anticipated :(

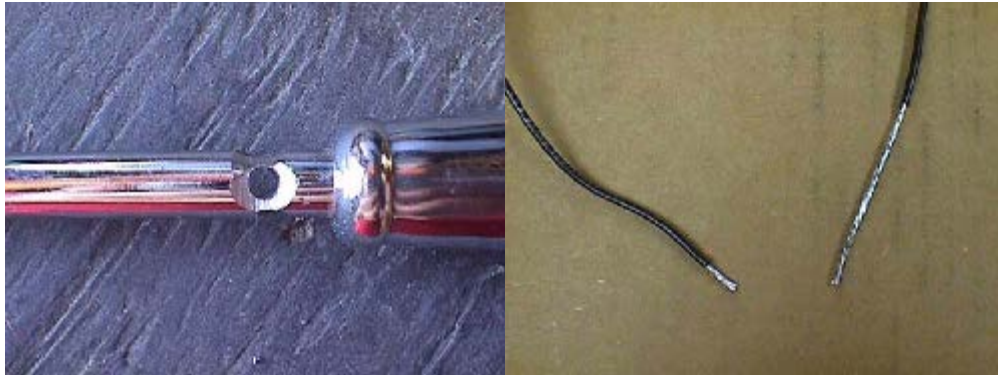
Enter the SafeBack, a safe way to use the method of discharge they had become accustomed to, regardless of the number of shock treatments they had received :) Of course, lots of them are seasoned pros now, helping other newbies to the group & old hands, as well. Anyway, this is another of those items that cost much more to make than I charge for them, and they take away time from the thousand other projects, so I've quit making & selling them, but as I did the last one I took pics of it step by step & will document everything here so that you can make your own.

You can get all the parts you need from your local auto parts store. You'll need a good size screwdriver, about 4' of 16 gauge wire (you could use an ordinary household extension cord cutting off the connector & twisting the wires together since they are so inexpensive & readily available), a spade connector and a battery terminal clamp.



Well... I started off with a 12" screwdriver as pic'd above and the first step was to grind off the plating up close to the handle as pic'd, ending with a flat spot in one area in order to be able to drill a 1/8" hole thru the shaft.





Hmmm... the pics are pretty much a step by step all by themselves :) Don't you just love digital cams :) Anyway, after doing all the grinding & drilling above, you can tin the blade where the grinder was used if you have a soldering gun, but if all you have is a soldering iron you can bypass that step.

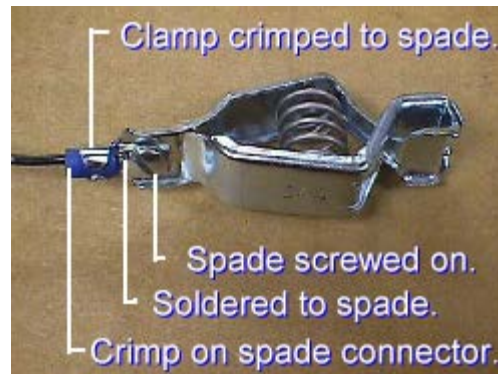
Next cut your 16 ga wire to 40 to 44 inches long and strip back the insulation on one end exposing 2" of wire, and on the other end you need to strip back about 3/8" of the insulation. Tin both ends of the wire & then feed the 2" end through the hole in the blade up to the insulation & tape it to the handle as pic'd to hold it in place. Wrap the wire completely around the shaft forming a ring. Since it is tinned, you can use pliers to bend it to a snug fit all the way around.



Now you can start soldering it in place by first filling in the thru-hole with solder & then continuing all the way around the blade and filling the other end of the hole, as well. After all the metal cools down, you can put a cable tie out near the end of the handle to act as a strain relief & insuring that the wire does not come loose in any way.



Now for the clamp end pic'd below. Start with crimping a spade onto the end of the wire with enough wire sticking through so that you can solder it to the spade, also. Once this is done you can fasten it to the screw on the spring loaded battery terminal clamp and crimp it to the spade terminal.



You're ready to go now and you can discharge from a safe distance without the worries of something falling off... everything is rock solid now. Just put the clamp anywhere on the metal framework as it is all tied to ground once a CRT is mounted. The grounding dag that goes across the belly of the CRT actually ties to the framework. Next just slip the blade up under the anode cup to ground out the *big capacitor*, so to speak, taking all the zap out of it. There is often a residual mystery charge left in the CRT, and a second, or even third, discharge after waiting a minute or two may give you a better peace of mind. Discharge upon reconnecting the anode wire, also. On some monitors you will hear the snap of discharge, but many monitors have built in bleeders to discharge automatically at shut down and will not make any noise. ALWAYS discharge even if you know a particular brand has bleeders because there is always a possibility that the circuit has opened leaving a huge surprise for the uncautious.

Now for a couple of often asked Qs that spawn from college text books.

Aren't you suppose to put a resistor in series with the ground line to bleed off the high voltage slowly?

I was schooled the same way a hundred years ago... put a bleeder resistor in the line to discharge the HV quietly & slowly... but I have not seen this in the real world, although surely some techs do, but in all the shops I've ever been in from Seabrook, NH to Gallatin, TN to Jackson, MS and out west as far as Fresno, CA, I just have not seen any techs that practice this. I asked one of the leading mfr's tech reps if they used bleeders in discharging in their shop & he said something to the effect of... you've got to be kidding... and that left a lasting impression with me.

With newbies & other collectors that haven't perhaps been working on their monitors for years & years, I personally would feel better with them hearing that snap of discharge that gives them a sense of security in knowing that they can proceed safely without getting the nervous shakes around HV circuits :(

Doesn't this damage the CRT if bleeders are not used?

IMHO this does not damage the CRT in any way. I have test jig CRTs for the various common place monitors that were used to work on op's chassis' that are 20+ years old & have been discharged certainly thousands of times, and more

likely over ten thousand times, and show no signs of damage... in fact, my K4600's CRT looks as good as the day I bought it... pristine.

Does the monitor have to be plugged in to an outlet connecting it to earth ground to discharge it?

I've answered this in a couple other places onsite & hundreds of times via email, but it still comes up, so I'll respond again right here where it hopefully won't be missed. Simple answer is no. Earth ground has nothing whatsoever to do with discharging a CRT. In fact, as I have said many times, you should discharge a monitor that is sitting in your garage by itself before pulling the chassis to work on it & you certainly wouldn't lug it to a game, plug it up to an isolation xformer, run an earth ground to it, plug the game up to an AC outlet just to discharge it. The charge stored in the CRT can remain for long periods of time & can even mysteriously recharge somewhat while just sitting, so you always ground from the framework to the anode to discharge it before grabbing onto the anode wire. I guess this is another place that needs a somewhat technic explanation that I never wanted to get into, but here it is as simple as I can say it.... a capacitor is 2 conductors separated by a dielectric (insulator), as taught fifty years ago & I doubt they've changed it... and the CRT, whether you want to call it a capacitor or "capacitor-like", has capacitance between the anode (+) and the dag (- black "painted conductor") on the outside of the glass (dielectric/insulator) which stores this charge. Just like you discharge your capacitor by shorting the + to the - or bleeding it off slowly through a resistor, the same is done to dissipate the charge in the CRT. When the CRT is mounted to a monitor metal framework there is a grounding dag which is nothing more than a spring & strap going across the dag ("painted belly conductor") & fastening to the metal framework, hence conducting the dag (-) to the easy to attach to framework for a solid ground terminal. If you handle a CRT that has had it's grounding dag clipped off then the only way to discharge it is between the black "painted" conductor & the anode.

In regards to the painted on conductor another faux pas that is emailed to me once in a while is this... I washed my monitor out in the driveway & scrubbed all that awful dirt & black gunk off & let it dry out for a few days & now it doesn't work! DO NOT remove the black conducting material. Only after positively discharging it can you use a dry rag & a soft bristled brush to clean the CRT belly & caution should be used as it is still subject to implosion.

Happy Gaming.....

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20EZ B+ Filter Cap Replacement

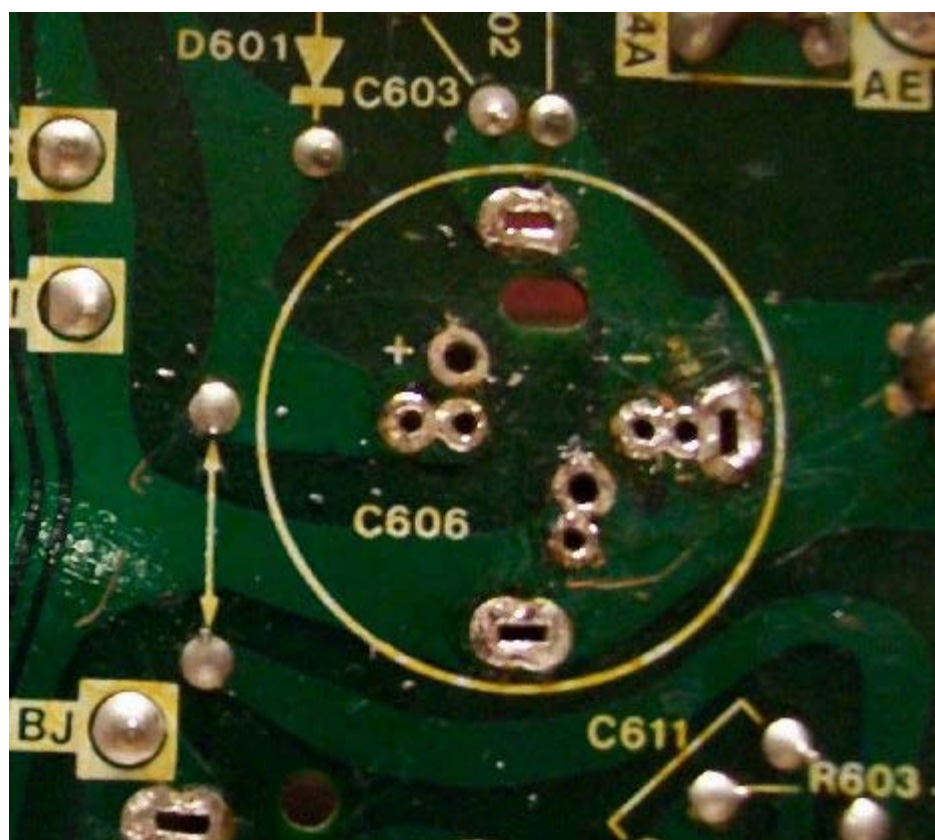
By Bob Roberts

Changing out B+ filter caps seems to give lots of folks trouble when it really shouldn't. I believe the first one to draw a lot of email was the G05 802 deflection board caps [C100 & C101](#) which would apply to the WG V2000, as well.

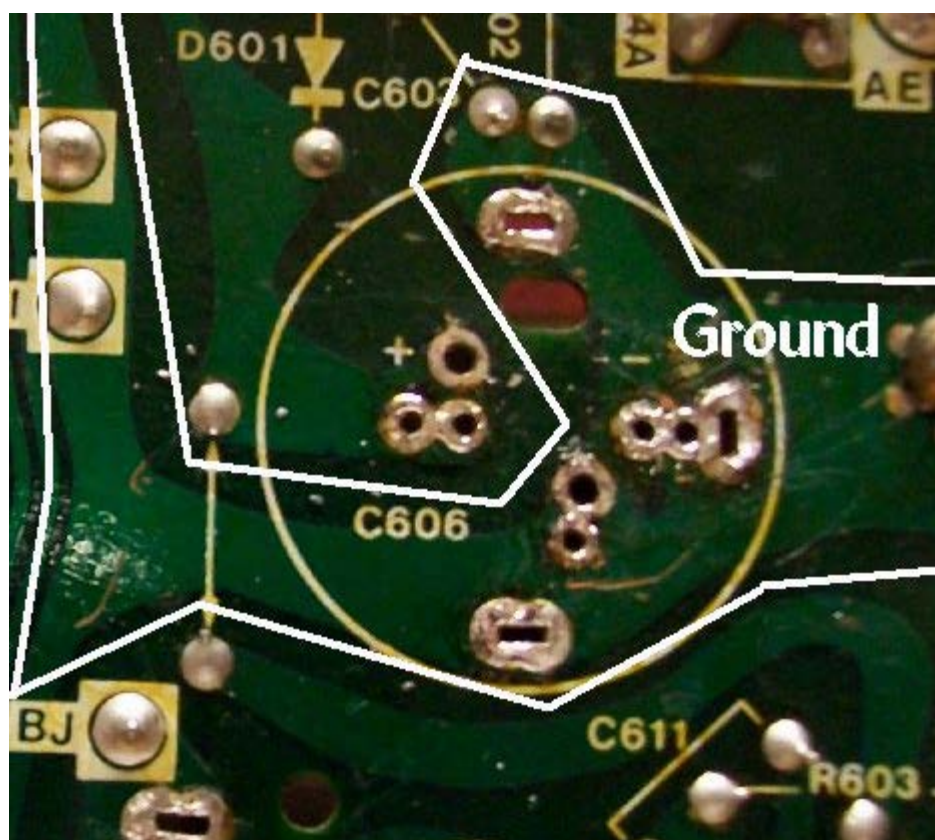
That was closely followed by the B+ filter used on the [G07 chassis](#). B+ filter replacements on many other monitors drew emails to a lesser extent, but pointing to the G07 guided those to fruition. The current one is the subject of this page... the Sanyo 20EZ B+ filter. The one question that seems to preceed installation is the voltage rating. The OEM is a 470uf160v & we ship 470uf200v snap-in caps as replacements. The voltage rating of a cap is how much voltage that the cap can safely handle. With the OEM cap it should be able to handle an applied voltage around 160 volts & exceeding that voltage will turn the cap into a cherry bomb. The 200v caps we ship only serve to increase that safety margin. The voltage rating a cap can withstand in a circuit is only limited by it's physical size. If your PCB only has a one inch plot for mounting the cap then you obviously cannot mount a two inch in diameter cap rated at 500 volts, but if that 500 volt cap will fit in the designated area & has the proper microfarads your good to go.

BTW: Ops never let the fact that the cap was too physically large to be mounted... just remembering the one I found in the bottom of a cab hanging by a lamp cord connected to the PCB :-()

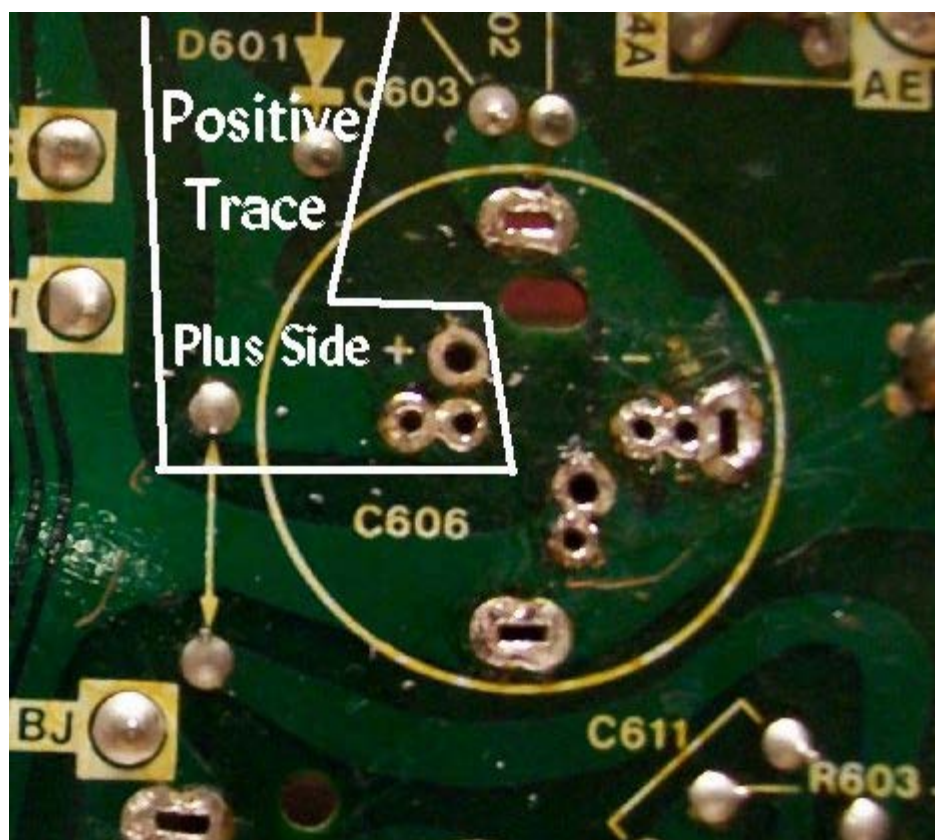
After getting the voltage issue behind & moving on, the next question is always about fitting the mounting holes.... it doesn't line up... the holes are too small... the holes are too close... the holes are too far apart & etc. Most chassis' will accomodate any cap layout via multiple silked positions. Unused holes will be solder filled & only need to be cleared if they are the ones you need for your particular cap.



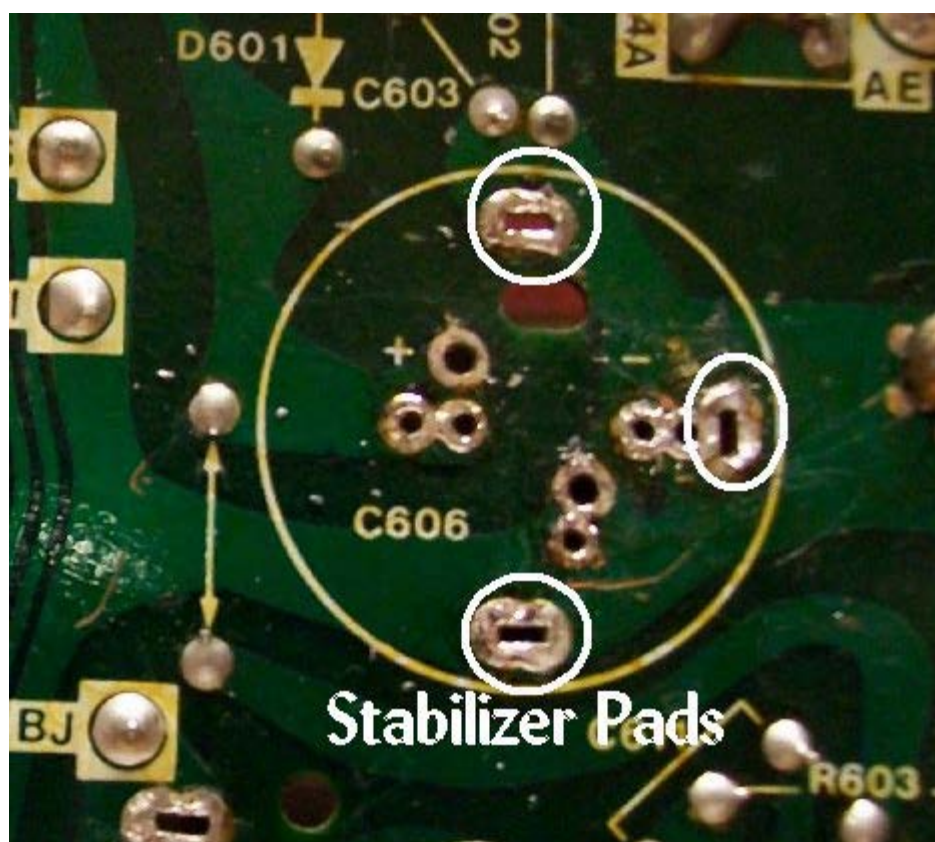
K... here's the C606 B+ filter mounting pads completely cleared out & you can see that there should be a pair of mounting holes for any cap type or size you can imagine.



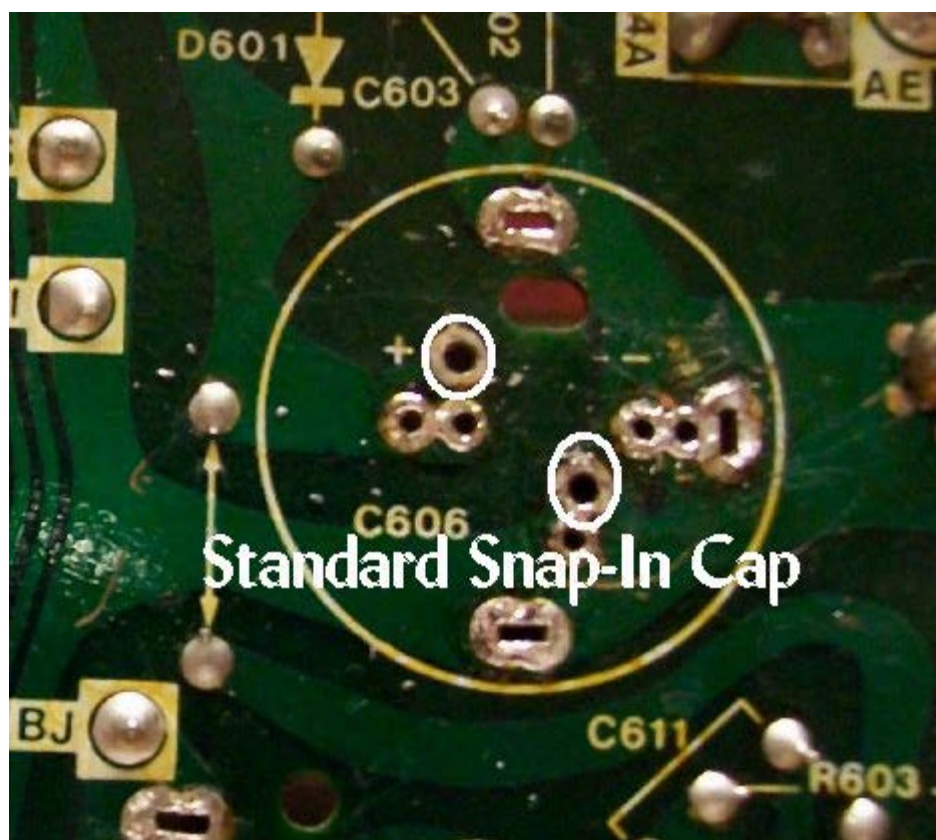
The ground trace is outlined above & it's easy to see that finding a hole won't be hard.



The same goes for your positive lead... if need be, you can clear all the holes to find the ideal pair for mounting.



There are even stabilizer pads to use a can-type cap & as you can see, they are all a part of the ground trace, as well, and could be used as a ground pad for your new cap, also.



Here are the holes you need for our cap & it is good practice to backfill any unused holes with fresh solder.



And... the coup de grâce... finished result!

Happy Gaming...

Replacing The 20EZ Flyback

by Bob Roberts

When I awoke from my customary 4 hours of sleep this morning I found that Alan was still having trouble installing a Sanyo 20EZ flyback in his monitor. It's been some 20 years since I laid eyes on a 20EZ & replacement flybacks were not even available at that time. Most of what I remember about that chassis was that it was a nightmare to work on, but had one of the better pics of the day.

Now these old eyes & now keyboard soft hands aren't much for doing the actual work any longer, but I figured I'd give it a try for old times sake. I decided to call the local guys looking for a 20EZ monitor to experiment with & got lucky on the first call... well, if you call fifty bucks lucky! I jokingly asked him what game came with it & without skipping a beat he says it's just the monitor & I think the flyback is shot. Well... lucky me... that's what I want to attempt to replace :-)

About forty-five minutes later I was the proud owner of a Sanyo 20EZ dead monitor. Actually, the screen looks to be in pretty good condition & it looks relatively clean in the back.



I'm thinking this baby has been in someone's home & not on the street for most of it's life. No bugs, no chewed up wiring, no hacks & no 2 inches of soot or nicotine on the back of the pic tube.



Let's take a look at that flyback hiding under this cage. Just four screws & it's gone!



Of course, you have to unplug the video inversion bd & it's 12V feed line to set it entirely free.



K... now it's gone!



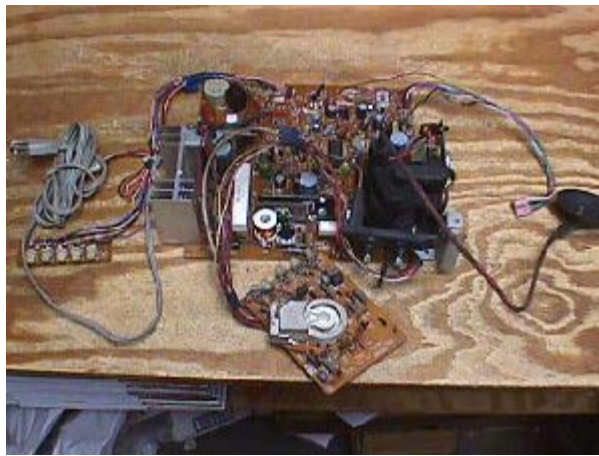
Hmmm... it appears his diagnosis was correct... nice hole burned in the top of the flyback allowing all that HV to escape into the atmosphere. Let me inject a little note here for any flyback that you suspect is leaking but that you can't see. Most times you can detect a leak by the pic flickering or the raster just dimming for a second due to the HV lowering as this occurs, but another way is by smell. Corona discharge produces ozone which has an indescribable odor that you will recognize after your first visit with it.... much like the selenium rectifier smell of rotten eggs when they went belly up.



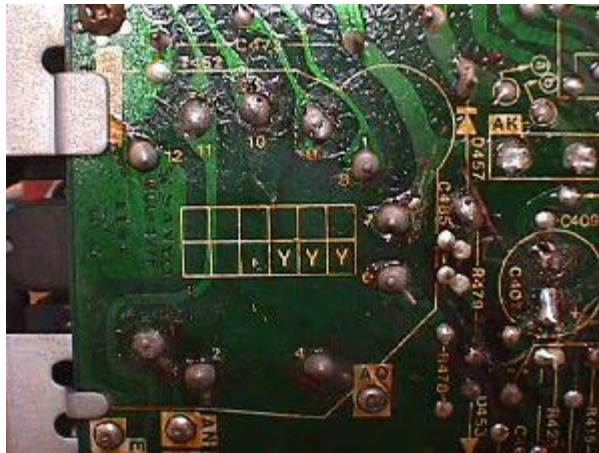
K... like the G07 & others this flyback uses a separate focus/screen block which you will have to reuse with the replacement flyback.



One screw attaches this block to the actual OEM flyback, so I can see other mounting arrangements will have to be made.



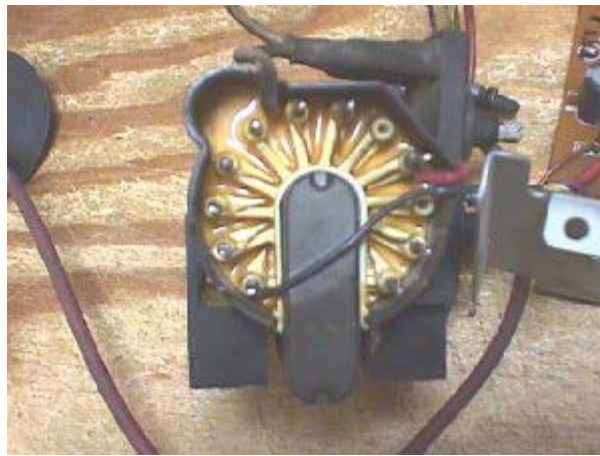
I noticed that this chassis does not have the audio amp installed, so it must have been used for JAMMA games or possibly a single classic game with it's own amp.



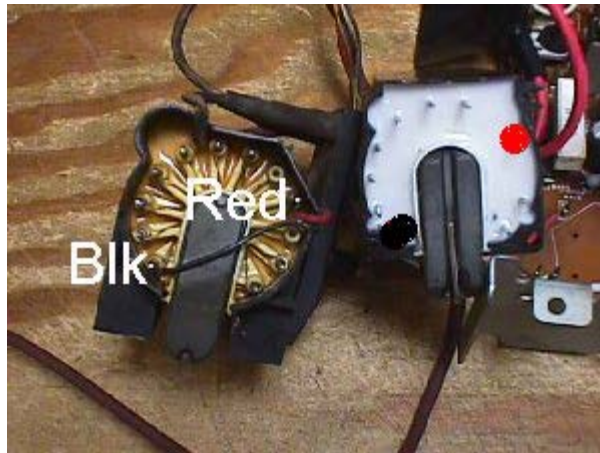
Dull grayish solder joints like these should have new fresh solder applied to them before trying to unsolder them, so that the solder sucker can clean the terminals free very easily.



With the OEM flyback free from it's mounting position you can see where they hid the screen control hook up... underneath & directly to the winding pins.



Heat the solder on these one at a time & slide them off making sure to note where they are attached.



It's best to just clean the wires of solder, so that they slip right onto the new flyback's pins. Slide them all the way to the bottom & solder them being careful not to put any solder on the lower part of the pins... they still have to go cleanly through the PC mounting holes.



Screen hooked up & now for the focus control. Cut the old focus wire about in the middle & remove the half that plugs onto the block. Remove the boot & place it on the new flyback's focus wire right away, so that you don't forget.



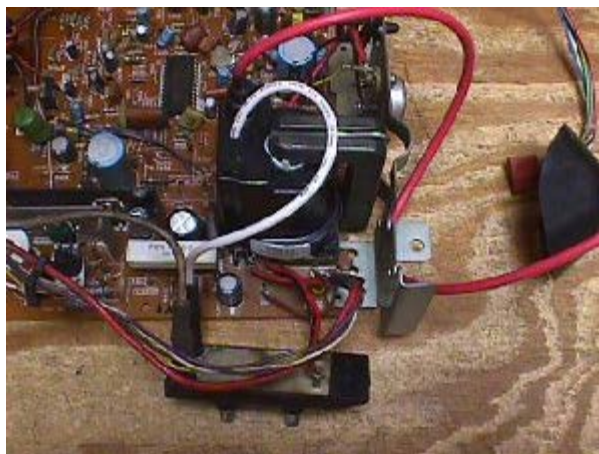
Next unsolder the pin that the boot exposed. A small screwdriver can be inserted into the space on the pin's insulation saddle & twisted to open the crimp releasing the pin.



Then put it on the new focus wire, crimp it to the insulation & solder it in place. Cool for a minute & then slide the boot on & attach it to the block.



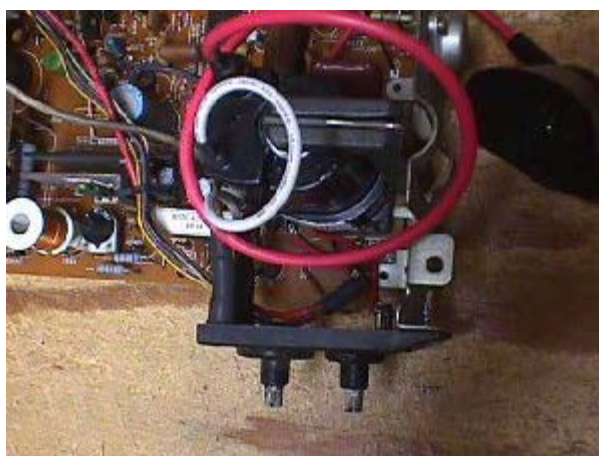
Now everything is hooked up & it's ready for reinstall.



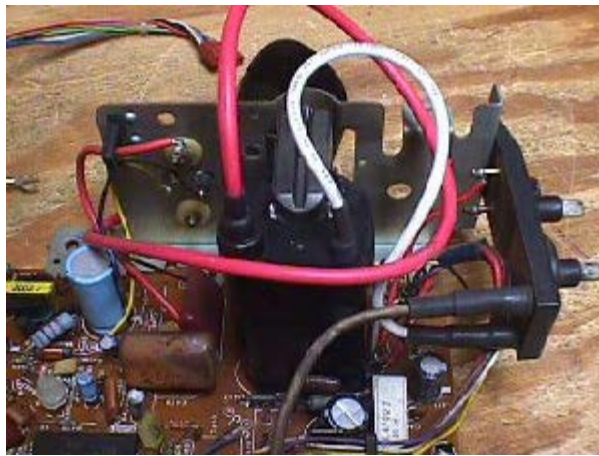
What to do for remounting the focus block now that the old perch is gone.



The simplest way that I see is to just drill a hole in the frame wall & attach it with a single screw again.



My preference at this juncture would be to omit the cage, but if you wanted the cage back the simplest way would be to cut out a rectangular piece of the back allowing the block to come through. I think either way is much more desirable then the guessing holes Sanyo allowed for making the adjustments in the first place.



My eight hours are up for this project & I have to return to your emails, but all that's left to do here is put it back on the frame in reverse order of your removal & you're good to go.

Happy Gaming...

Sanyo 20EZ Picture Weaving

by Bob Roberts

Once something is posted to the internet it stays there forever & is continually referred to over & over again. Just when you think it is dead it rears up again to prove it was never buried. I've had my share in several cases. When someone cannot find their problem they jump to it's a defective part. I've been hunting for a defective part for over 50 years & have not been lucky enough to find one yet.

First it was power supplies which are tested here before they ever ship out & I've yet to find one bad from the get go, but still test them all. At first, I allowed several to be shipped back for retesting. I opened one & found everything fried inside! Contacted the person & got the story of lightning hitting a transformer outside & frying all his appliances in his home. That's not a defect in the power supply?? Another had 120VAC hooked up to the 5VDC output... turns out that wires were transferred from the old one position for position without regard to the label. Power supplies are not universal in their terminals... 5VDC may be the top terminal on one while being the bottom terminal on another, or anywhere in between. You have to arrange connections accordingly. This is why we hand wire all of our linear PS to switcher adaptors... you can hook them up to any power supply & are not obligated to buy one certain power supply with corresponding terminals. Defective power supplies to date: none.

The next case was the 7905 regulator that was posted as being defective. Turns out that most of the cases reported did not even use the -5 volts for the game leaving the reg unloaded under power. Did a page on that one & still it comes back at least once a year. Defective 7905s to date: none.

Then it was flybacks... I was shocked to see that monitor repair shops were jumping in on this defective internet legend. When several of the community repair services said that flybacks they had installed did not work I had them send them back to me for testing. I grabbed one of the \$15 parts chassis' I had on hand & tossed the first one in thinking I was going to have to do other repairs to the chassis just to check the flyback. To my surprise it fired right up & survived a 24 hour burn-in after being told the flyback was dead. I had no sooner returned it when the second came in.... popped it right on that same chassis & although it was reported dead it too fired up & passed burn-in. After doing this several times I had to put a stop to it... no defective flybacks were found & it was a waste of time & postage. The first thing you need to do after installing a flyback & coming up dead is to check over your work & be sure that there are no cold solder joints & that even the good solder joints have continuity to the next component in line. Many times in pulling the old one out a trace will get a hairline crack breaking continuity from the flyback terminal to other components in the circuit. Defective flybacks to date: none.

That brings us to the last one that keeps returning on a regular basis.... the LA5112 regulator found in the Sanyo 20EZ. Way back in the last millennium when someone could not find the cause of the weave on their monitor someone suggested it was a defective component from us. I covered this one more than any other rumor because it turned up more than the others combined due to the fact that this monitor is prone to that problem & has several natural causes & a few man-made ones. I've ordered

from no less than 3 sources & different batches & still it persists. I've tried them in monitors & they work fine. I've had 2 that were diagnosed by shops as definitely bad returned & tested & they both survived 48 hour burn-ins with flying colors. Outside of all the extra work & steps I took was the fact that many reading this for the first time went to the trouble of buying replacements at double the price & ending up in the same condition after installing them & those who spent time in pulling OEMs off other chassis' & installing them in the questionable one only to find no difference. Defective LA5112 to date: none.

Your 20EZ has a slight weave to the pic then in order:

- **Cap Kit**
 - More often than not this will take care of your weave.
- **B+ Filter**
 - If bad easily spotted, but weak from declining value just a slight weave.
- **Regulator LA5112**
 - Care should be used in replacing this in-line or your work could be a problem.
- **Current Limiter 2SD1090**
 - This is a less likely suspect, but nevertheless it has been found to be the source of a weave.
- **Flyback Xformer**
 - The only way we have proved out this cure is by substitution.
- **Pic Tube**
 - Heater to cathode short. 50/50 using a CRT restorer. Anywhere from unsalvageable to 1 year up to multiple years after booting.

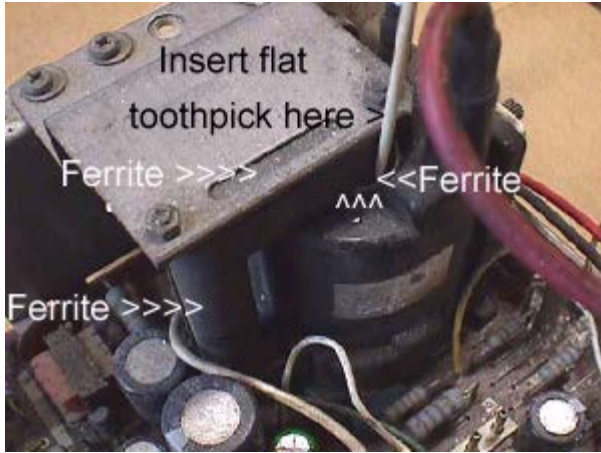
Toss this list out the window if you created a man-made problem such as shorting something with a screwdriver, forgetting to cut spews from a cap before reinstalling, shorting something while trying to adjust pots or any other thing that goes pop or produces a spark display.

Singing Monitor Trouble

by Bob Roberts

I've heard a number of descriptions on this one...whiny...whisling...singing... high pitched noise/squeal...changes frequencies all the time & if I rap it on the side of the cabinet, it will stop for awhile, but start up again, so what's my trouble? Wellll.....

Flyback resonation is caused by the flyback being loosened from the ferrite core. There are several things you can do to stop it, but the easiest & what should work for you can be done with the monitor off.



Take a toothpick & look for a separation of the flyback from the ferrite core in the center...most times you will see what appears to be a cardboard tube/sleeve around this & sometimes they are real tight & other times you can see right into it...any place you see that looks like you can start the toothpick into the core to act as a wedge, do so with either end. Once you have it wedged in there you can try your monitor again & if it has stopped resonating, you can power down & snip the excess toothpick off flush with the top of the flyback's sleeve.

If room does not permit this procedure, your only alternative is to remove the flyback & try to wedge the bottom & reinstall. Sometimes just removing & reinstalling without doing anything else, will cure this problem. Repositioning becomes the cure.

Happy Gaming.....

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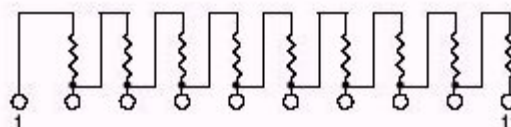
What Are SIP's?

by Bob Roberts

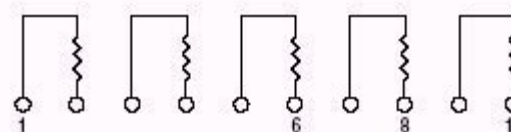
SIPs are nothing more than a network of resistors in one package. There are numerous types of cases including the chip array that looks like a simple IC, a surface mount similar to an IC with it's leads flared out to the sides like wings, but the most common one that we deal with in the classic game boards is the in-line through-hole SIP (Single Inline Package).



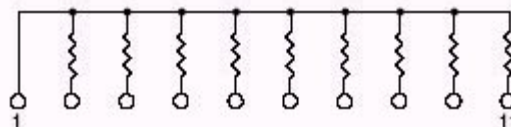
I'm going to just generalize here & cut to the chase as quick as I can. There are quite a few sub-types to this through-hole SIP type such as the *series* type:



The *isolated* type:

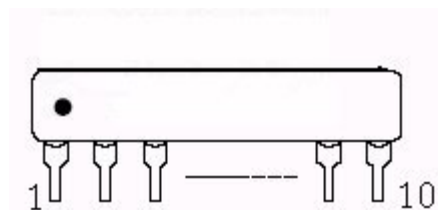


There are others like the *ladder* type and combinations with caps to produce RC networks, but the most common type to vids is the *bussed* resistor network.

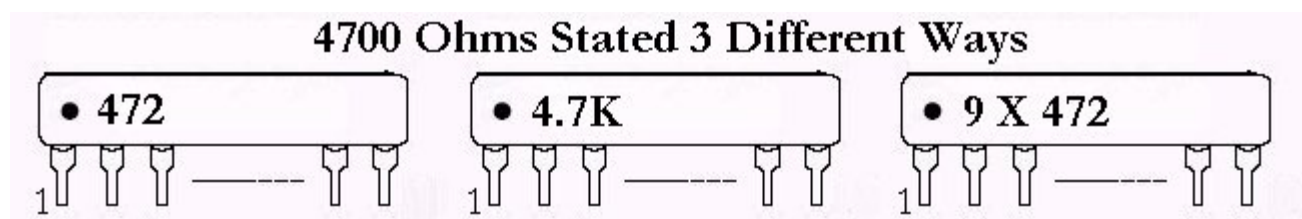


These are used as pull up or pull down resistors, so the lead marked with a dot on most, and a 1 or indented circle on others, will mark the common lead to each resistor. With some of the imports I've noticed that just a stripe is used or they just cram the identifying lettering to the end signifying the number 1 pin. Of course, if there are no pointers at all to the number one pin you can always use an ohmmeter to locate the common end. Whatever the value of the SIP is will be measured the same to each pin from the common #1 end pin. Measuring from the wrong end will result in a doubling of the

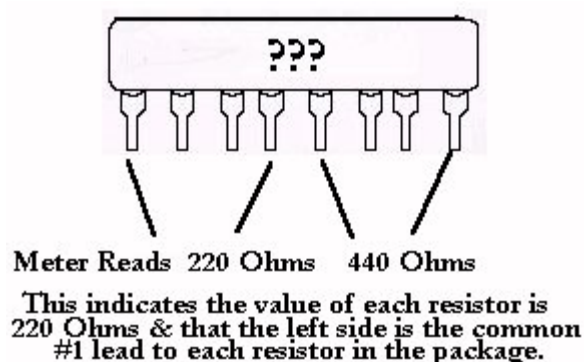
value to the next pin because you will be reading 2 resistors in series with each other.



This array of bussed resistors typically come in 4,6,8,9,10 & 11 pin packages. If you order an 11 package what you'll have is 10 resistors because the number 1 pin is the common for each resistor. It's helpful when looking for these when it is fully spelled out for you, e.g., 11 Pin SIP 10 Resistor Bussed Network, but I find that is seldom the case. They expect you will know what you need & it often times leads to order errors.



When it comes to the value of each resistor in the network it can get confusing by the way it is stated on the component. Many have long part numbers on them that hide the value within them. Some use typical resistor written code expressing the value, while others clearly stamp the value directly on them. If you are not familiar with reading resistor shorthand you can get a general idea on the [Trimmer Pot Page](#). Remember, if all else fails you can always use your ohmmeter to come up with the value... it'll be the lesser value of the two measured from either end to a middle pin. Let's see that one... has to be less confusing:

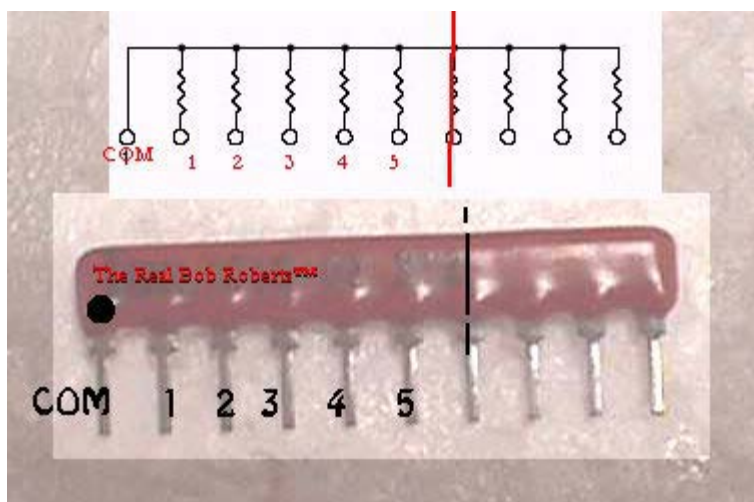


Here's a tip: If you are measuring one to replace the above example and you read 660 ohms in place of the 440 ohms in the pic, you've got the wrong type of SIP because you are actually reading three resistors in a series network.

Okay... these are important to the classic boards for a couple reasons & why I'm taking the time to do this. First is that they often get mishandled & broken. Secondly, with so many used as pull up/pull down resistor banks, they frequently are the cause of inoperative controls. Whenever you see these SIPs you should carefully inspect them... perhaps even using a magnifying glass... to be sure that they have no hairline cracks in the encasement. If you have a control panel switch that is dead & it has a SIP used as a pull up, you can use your meter to see if a voltage equal to other operating pushbutton switches is present on the offending switch. If it is not present, and after confirming wiring to be good, you can trace back to the one resistor associated with the offender in the SIP & if it still is missing ... with other pins measuring correctly... then you need to replace that SIP.

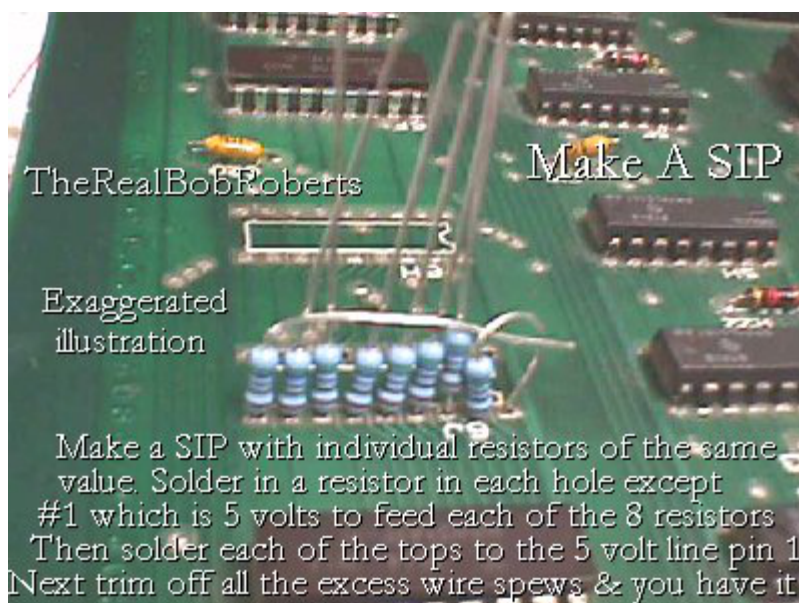
Now that I've outlined a brief basic idea of what these SIPs do for us, I'll toss in a couple cheats here that you may want to use when you get stuck with the age old problem of not being able to find the correct component that you need. For instance, in the last paragraph, when you find one resistor in the package is open, you can get a single resistor of the same value as the open one & bridge it in from pin 1 common to the dead output pin lead.... effectively replacing the dead soldier within the fortress. You do not necessarily have to be on the pins themselves as you can tie to other solder points that are directly connected to the pins you need to use for bridging.

A second cheat is a little more dependent on your skills & requires a Dremel type tool. It does the trick without looking too ugly, in fact, a dab of Magic Marker for the finish product usually makes it undetectable by most, unless pointed out.



Let's say you require a SIP with a bank of 5 x 1K resistors plus the common for a total of 6 pins. You search the world over for one, but all you can find is a 1K SIP with a bank of 9 x 1K... as pic'd above. You only need 5 resistors & you have 9, so you simply go to resistor 6, pin 7, don your goggles & use your Dremel to cut right down the center of resistor 6. This will eliminate the unwanted resistors while making sure that resistor 5 does not get damaged. Note that the numbers pic'd indicate the resistors & not actual pinout. You can cut closer to resistor 5 if the footprint you are working with requires it. If your footprint is unchallenged on the PCB, you can simply cut the unwanted pins/legs from the SIP & install it complete without any fancy Dremel work.

K... here's a last resort cheat that many like even better. I've been sending the pic below out for many years now & it is finally time for it to be where all can see it... crappy as it is, the point always seems to get across right away. It's not a finish product, but rather one that illustrates the concept better. I'm really glad to get to this point as I have been working on this page for nearly 2 years time.. you know, not full time, 5 minutes one week & 10 minutes a month later trying to figure out what you were trying to convey in the last 5 minutes spent on it & what was done with the pics, and of course, adding another 5 minutes to it. Suffice it to say that this is one of a hundred started that is nearly done... phew! :-) Yes... the pic is coming :-)



We still have a few odds & ends of SIPs on the [Parts Page](#) and since there are so few, I'll go ahead & make a table of them here.

10 Pin 470 Ohm x 9

8 Pin 1Kohm x 7

10 Pin 1Kohm x 9

10 Pin 2.2Kohm x 9

10 Pin 4.7Kohm x 9

K... that's probably not half of what I was going to say & do when I started this page, but it's all I can remember right now, so it's finished & I hope it'll be of help to at least one person.

Happy Gaming...

///Slanted~~Picture///

by Bob Roberts

Wells-Gardner K4600

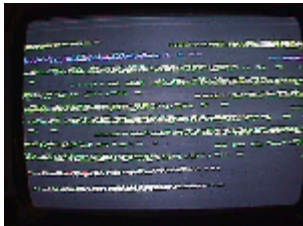
(HIGH VOLTAGE!! CAUTION MUST BE USED DURING ADJUSTMENT!!)

Symptom:



The screen has horizontal bans of color like a barber pole or maybe almost straightened up, but not quite, so that the picture is slanted. Some pcbs may work fine, while others don't. Treble pic images stable on screen. Just not enough H range period & a host of other complaints right up to a bend in the top of picture.

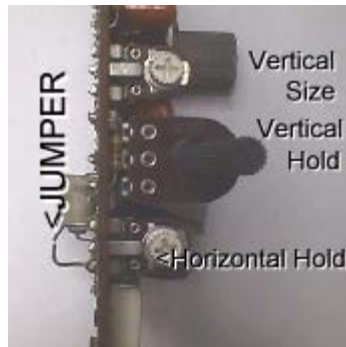
Cure:



The horizontal frequency has drifted off from center. Locate the horizontal hold control on the vertical pc card on the right hand side of the chassis. It is the white knob on the bottom under the long protruding black knob (V. hold). Set it to it's mechanical center & leave it.

In the center of this same vertically mounted pc card, you will see a shiny metal square can about 1 inch down from the top. Looking into it you will see a red screwdriver slot. You'll need a 12" plastic screwdriver to feed through the hole on the metal chassis frame, that lines up with this screw slot in the can & adjust it until the picture straightens up. If you go the wrong way and the picture goes out altogether, don't worry, just go back in the opposite direction for a few turns & turn the monitor off for a minute & then back on. This resets your auto-shutdown circuit. Now you can continue

going in the right direction until the picture is upright.



This should solve your problem & if you use your cabinet as a multi-game cab, you should try several of your pcbs in the game & adjust the small white horizontal knob to a position where any of the pcbs will plug n play.

If you still are having trouble with sync circuits, some V/H bds require a jumper across C315 eliminating it from the circuit when used with certain game pcbs, while others need C315 in circuit. There is usually a bare wire jumper on the solder side of C315 that can be cut open or tacked together as needed.



A couple of wires attached to these points with a Molex 1 pos connector in the center would be a good idea on a cab that is used as a multi-cab. Once these have been installed, you can run a pair of wires up to the coin door & mount a switch to take this cap in & out of circuit if you have a front drawer system cabinet and don't need to be in the back of the cabinet for any reason. Be sure to use the Molex 1 pos connector (M & F) to plug your remote switch wires to the V/H card by interrupting the bypass already installed. This ensures that it can easily revert back to the card plug to use it for testing other monitors or for any reason that

you would remove it, it would still operate stand alone & without you having to fish all your coin door wiring out with it.

Yes, I see the Q coming.....can I move the rest of the controls up front?

Yes. If you have lots of time on your hands, you can unsolder the other controls & mount them on a perf board up near the coin door & run a shielded multi-wire cable to the V/H card. I would definitely break this cable as it leaves the V/H card with a Molex multi-connector to facilitate monitor repair.

While you are here, you may as well know about a couple other quirks of the K4600. If you are still experiencing horizontal difficulties, or vertical for that matter, these 2 plug in cards....actually 3 as the regulator card to the far left, also plugs into the main....often have cold solder joints on both the header pins on the main board & the card connectors. To remedy this you need to flow a bit of new solder into the old to soften it for removal. The little \$5 solder sucker is the quickest way to clean this old solder out. After you have a few pins cleaned, you can flow some new solder onto them before proceeding, to maintain stability to the end.



Another quirk that is often overlooked is the cap at position C614 on the main board. This cap bridges the pincusion xformer and when it grows weak it causes the picture to appear trapezoidal, or what techs call "hourglass" or "keystone". The center of the pic can bow inward) (or outward (), hence the 2 terms. The reason it is overlooked so much, is that in their infinite wisdom of design, they chose to mount this under the V/H card between the 2 connectors, forcing the radial cap to be mounted with extra long leads & then bent to a laying out-of-the-way position on the main board to allow the V/H card to plug in.

If you encounter the treble image or double image when changing out a monitor other than the 4600, your chances are very good that you have a medium resolution monitor rather than a standard resolution monitor, as the 4600 is the only CGA that I've seen capable of going that far off frequency to exhibit that symptom prior to shutdown.

Happy Gaming.....

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Speaker Replacement

by Bob Roberts

I must have typed this out a thousand times over the years, so I know this quickie page will help many of you. The typical email starts out with where can I get a 8.75" round speaker for my xyz game? Other than the std 6x9 & 4x4 speakers there are many cabs with odd sized speakers that just can't be found today, or if they are, then they cost as much as the cab itself. This is going to be a quick outline of how we handled the odd sized speaker for ops. I'm going to go from 6x9 to 4x4 because I have those speakers readily available.



The first step is to remove the speaker you are replacing. Then find a piece of scrap paneling. If you don't have a piece you can probably pick up a small piece from Home Depot or even a damaged full 4x8 sheet.



Cut a piece of the paneling a little larger than the speaker you are replacing.



Center your old speaker on the paneling & mark your bolt holes.



Center your new speaker on the paneling & mark your bolt holes.



Connect your diagonal bolt holes with a marker to find the center.



Drill the mounting holes & cut the center out staying within the new bolt hole pattern.



Paint the paneling overall with flat black paint.



Mount your new smaller speaker to the paneling with carriage bolts. If you don't have black bolts you can hide the heads with the same black paint you used for the paneling. Now what you have essentially is a replacement for the odd sized speaker & you just mount it back in the cab using the old bolts, or new if you have them. Use the same speaker grille that was there in the first place. Everything is hidden & for all appearances nothing has changed from the OEM.

Happy Gaming...

Super Pac-Man To Jamma

Notes To Aid In Making An Adaptor

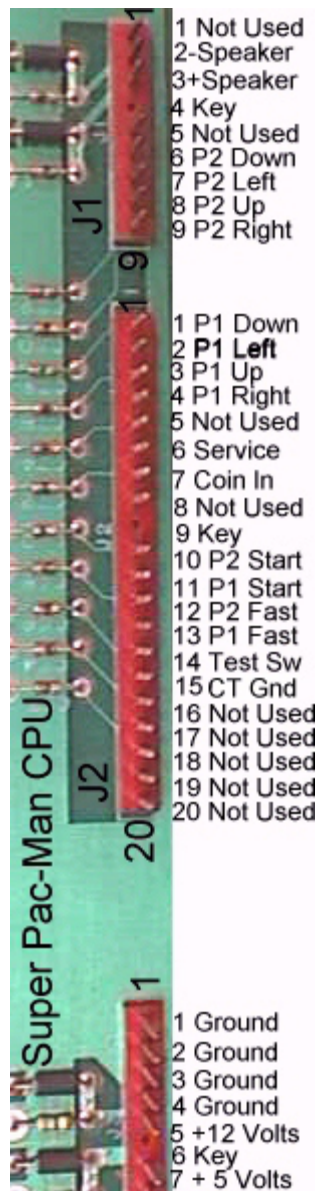
By Bob Roberts

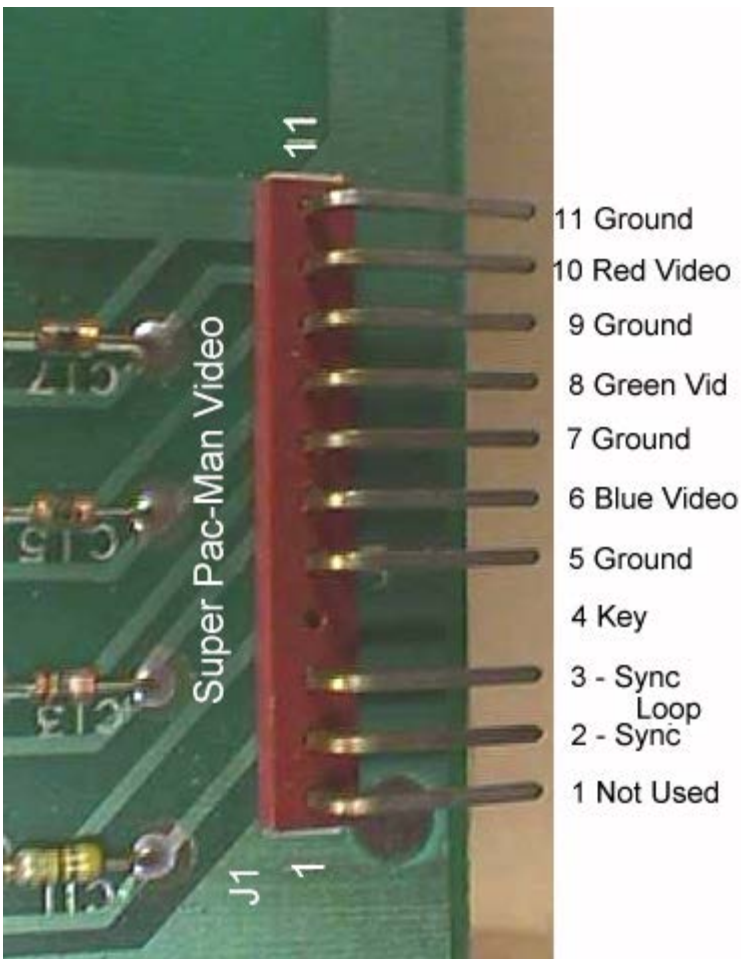
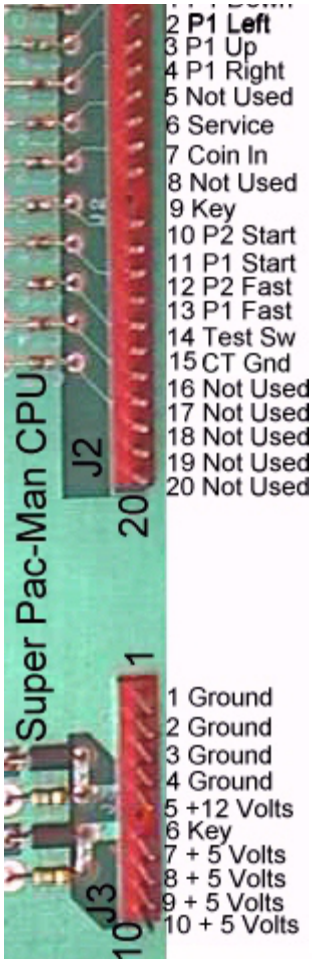
Foreword: Aloha Steve.... Well, I thought everyone would be able to wire up a straight forward reroute of wiring for the Super Pac-Man to Jamma Adaptor, but someone has finally had a problem doing this, so to aid anyone else that is attempting to make one of these adaptors I'm going to put my notes up here along with a few pics. Happy Gaming all....

SPM pinout rerouted to Jamma. This can be set up in cocktail table mode by grounding J2P15, so both 1 & 2 players need to be wired, and a bullet connector placed in the ground line that goes from J2P15 to Jamma ground. Unplug the bullet for upright games & plug it together for cocktail table operation to flip the pic.

To reduce resistance, use 3 of the 4 grounds on the video board at J1P5/7/9/11 split up to return to 3 of the 4 double Jamma ground pads on the fingerboard and use the 4th for the Jamma video ground. Use 18ga wire for all 4 +5 volt terminals at CPU J3P7/8/9/10 back to the fingerboard, as well as, for all the grounds to the fingerboard.

Coin 1 in at CPU J2P7 can simply loop from Jamma coin 1 in to Jamma coin 2 in, or you can run coin 2 over to coin 2 on the SPM side at J2P8.





The Real Bob Roberts™

JAMMA > SPM Pinout

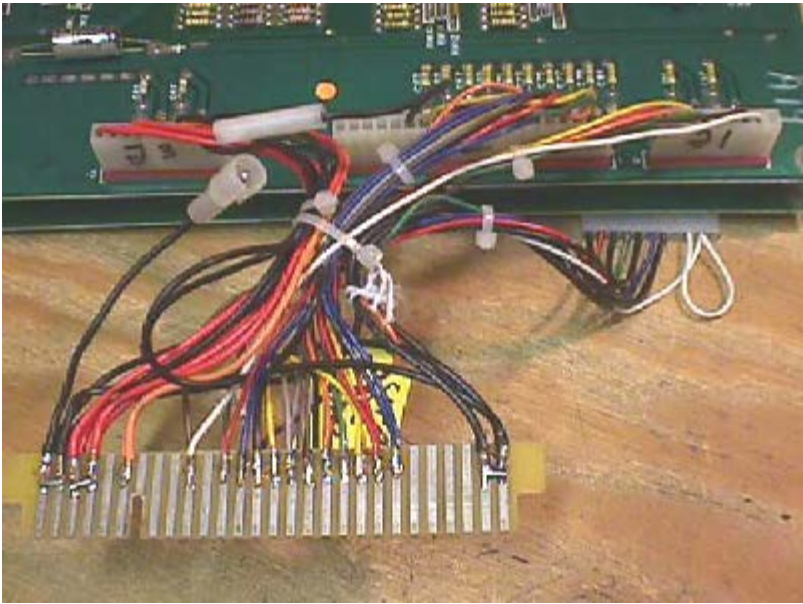
PARTS SIDE			SOLDER SIDE		
CPU J3P1	Ground	1	A	Ground	Video J1P11
CPU J3P2	Ground	2	B	Ground	Video J1P9
CPU J3P7	+5 volts	3	C	+5 volts	CPU J3P8
CPU J3P9	+5 volts	4	D	+5 volts	CPU J3P10
NU	- 5 volts	5	E	-5 volts	NU
CPU J3P5	+12 volts	6	F	+12 volts	CPU J3P5
NA	Key	7	H	Key	NA
NU	Coin Counter 1	8	J	Coin Counter 2	NU
NU	Coin Lockout	9	K	Coin Lockout	NU
CPU J1P3	Speaker +	10	L	Speaker -	CPU J1P2
NU	Not Used	11	M	Not Used	NU
Video J1P10	Red Video	12	N	Green Video	Video J1P8
Video J1P6	Blue Video	13	P	Composite Sync	Video J1P2&3
Video J1P5	Video Ground	14	R	Service Switch	CPU J2P6
CPU J2P14	Test	15	S	Tilt	NU

CPU J2P7	P1 Coin	16	T	P2 Coin	CPU J2P7/8
CPU J2P11	P1 Start	17	U	P2 Start	CPU J2P10
CPU J2P3	P1 UP	18	V	P2 Up	CPU J1P8
CPU J2P1	P1 Down	19	W	P2 Down	CPU J1P6
CPU J2P2	P1 Left	20	X	P2 Left	CPU J1P7
CPU J2P4	P1 Right	21	Y	P2 Right	CPU J1P9
CPU J2P13	P1 Button 1	22	Z	P2 Button 1	CPU J2P12
NU	P1 Button 2	23	a	P2 Button 2	NU
NU	P1 Button 3	24	b	P2 Button 3	NU
NU	P1 Button 4	25	c	P2 Button 4	NU
NU	P1 Button 5	26	d	P2 button 5	NU
CPU J3P3	Ground	27	e	Ground	Video J1P7
CPU J2P15 NO	Ground	28	f	Ground	CPU J3P4

The Real Bob Roberts™

Wouch! Too much typing, or thinking, or both, & I've got a headache now, so I hope this proves useful to at least one other person. I put the JAMMA pinout hugging the centerline with the SPM pinout in the outer columns. I find this way of mapping to be very helpful to people who are not use to following industry maps, i.e., the electronically challenged :)

That's about all I can think of, so I'll put the finish product below.



Here's another pic I found of a completed one... more of a side view.



Looks like an easy one to wire up, just time consuming. The adaptor kit comes with the fingerboard, connectors, pins & keys, so other than your time, wire & solder... that should be all you need to get Super Pac'ing.

As always, all the parts you need can be found on the Parts Page.

Addendum: Okay... so you want to play SP-M for free, huh? Yes, we can do this the somewhat more labor conscious way without touching the cab by means of the adaptor card. All you need do is run a jumper wire through a bullet connector from JAMMA "T" to "U" to accomplish this feat. When you want it to be in the free play mode simply plug the bullet together allowing for you to push the 2-player start button to coin up a game for one player, or pushing it twice will send you into a 2-player free play game.

Want to be able to control this option easily? Mount a simple on/off switch via an easily removed cable tie to the harness just inside the coin door and run a pair of wires from it to the adaptor. Now using bullet connectors simply plug onto the ones on the adaptor to extend this feature out to the easily accessed coin door. This will allow you to make any adaptors you want utilizing this feature with remote control, while still being self-sufficient if used in a cab without this provision. I would use a wire color different than that of the CT jumper wire with bullet plug to keep from cross connecting the two. Red should stop any thinking person from mating one of these to the black CT jumpers :) Universal 5 volt color to universal ground color always makes a person stop to ponder a bit... granted not long enough in some cases, but here no permanent damage can be done, anyway.

Of course, you could use a 2 or 3 position Molex connector to accomplish this quick disconnect & use a separate jumper plug when a cab switch is not available, but I have found that these have a tendency to get lost... even when I have tethered them to the adaptor card:(Anyway... this is just a simple wiring wizardry to mimic what I have been saying to do to the cabs for years now, making it into a free play mode machine. Of course, if you are not a purist, you can simply install this on the cab side permanently to switch in & out of 2-player free play mode. Note: Yes... I said purist.. remember that not so long ago ops were gutting out what make you cringe now, so I expect by the time JAMMA 3 is in place, these Jamma cabs will be the "OMG, you didn't do that" cab of the day...classic! This would save you from individual adaptor wiring on a continual basis, but be advised that some game boards will not function in this mode. Some IOs will detect this as a short, i.e., a closed switch, while others will see it as a tilt & shut down the CPU. You would have to flip the switch to the open position whenever you encountered one of these in order for the CPU to operate. When you have a game board that has the free play option via IO, I'm still in favor of using this method over the dip switch method because I find that using the dips will eventually burn a pattern into the CRT's phosphor... sometimes very quickly if the CRT drives are set higher than they need to be.

Happy Gaming.....

A Quick Look At Sync'ing

By Bob Roberts

Over the years one of the things newbies have found very hard to comprehend is sync'ing the monitor. I'll put a very general, non-technical, synopsis of synchronization here along with a couple pics for common monitors.

Basically, you want whatever game board you are hooking up to sync your pic horizontally... from side to side (right to left) along the longer axis... and sync your pic vertically... from top to bottom along the shorter axis of the screen. Looking at your monitor as you would watch a TV, a lack of horizontal sync will allow your pic to drift by right to left, perhaps as a whole viewable pic, or a pic with diagonal colored lines through it due to the horizontal hold being off-centered. A lack of vertical sync will allow the pic to roll up or down & it is often thought of as a vertical circuit problem by newbies who are totally frustrated by their attempted adjustment of the vertical hold. Actually, both the horiz & vert hold controls act this way, but most often it is the vertical that frustrates so many. I hear... I turn my vert hold control & the pic slows down & will even stop perfectly for a second or two, then it takes off rolling again in the opposite direction! I go back & forth over the center point, but it won't stop rolling for more than a second :-(Should I change my vert output transistors, or what? This is clearly a lack of sync & not a vertical output problem.

Your game board is going to supply the vert & horiz sync signals needed to stabilize your pic on the screen. Some bds supply 2 positive signals to accomplish this, some 2 negative signals, some a single composite positive signal, some a single composite negative signal, while some boards are capable of supplying all the above via jumpers on-board. I don't like utilizing the jumper system because it takes away from the standard of the particular board, i.e., a Defender bd once changed from the norm will not just slip into another Defender cabinet and work.

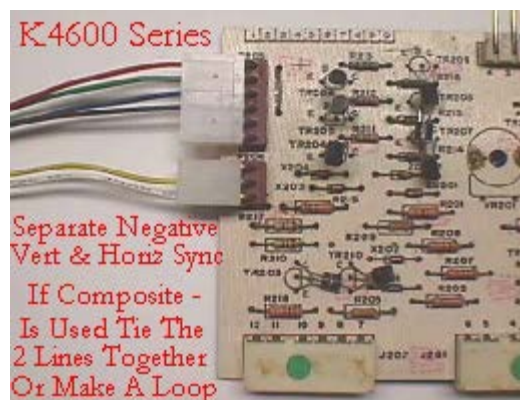
JAMMA & most game boards these days utilize the single composite negative signal... both a vert negative sync signal & horiz negative sync signal combined into one feed line. The pic below is of a typical video/sync input harness. It has provisions for the separate horiz & vert sync signals to the monitor, but in this case a JAMMA bd only has one composite signal line out, so you need to combine the 2 wires into one pin. When dealing with an OEM harness this is typically fed with one line up to the negative horiz sync post on the monitor & then jumped over to the vert sync post with a single short wire referred to as a loop.



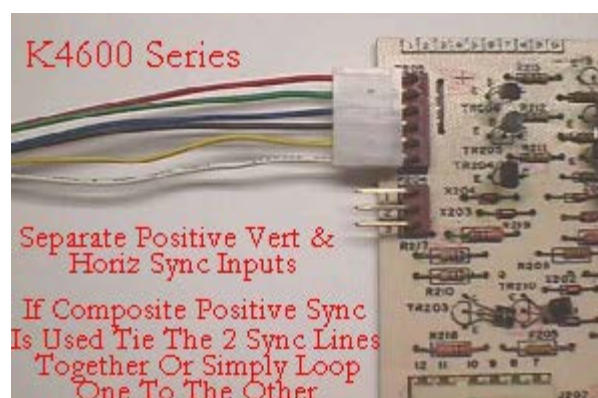
Notice in the pic above that the positive sync inputs are empty, but if you were to use this particular harness on a Defender or other Williams game of that era that used positive sync signals, you'd have to move the sync wires to those empty positions.



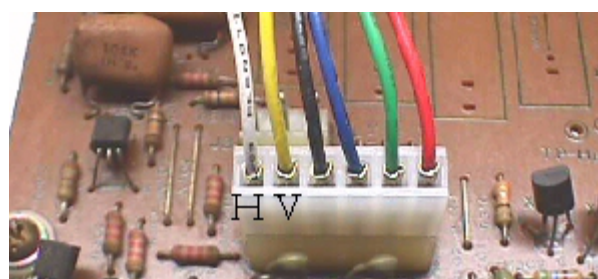
You can see in the pic above that the 2 sync lines share the same pin for JAMMA bds & this is electrically equivalent to the short jumper loop found in OEM wiring.



Above & below depict connections to the Wells-Gardner K4600 series monitors and as you can see, like most monitors, it has positions for both positive or negative sync signals from bds. A composite negative output Pac-Man board would connect up as above with both lines tied together, while separate positive sync signals from a Defender would connect up as in the pic below.

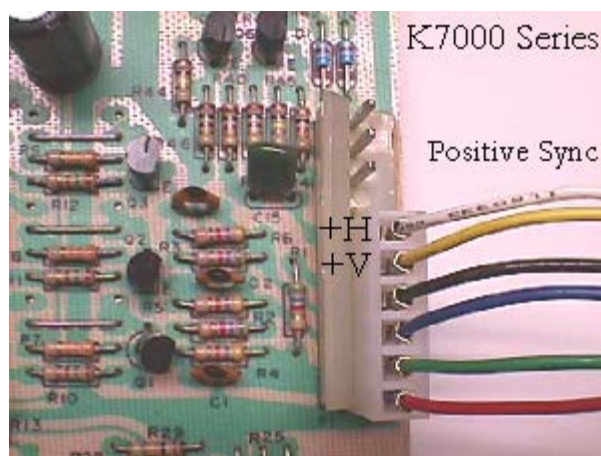
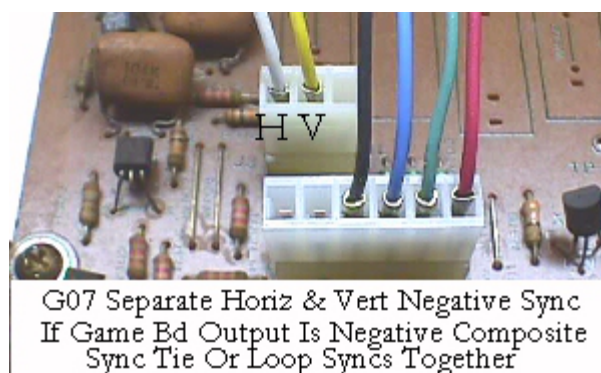


The K4600 has some other issues with sync that were previously covered [here](#).

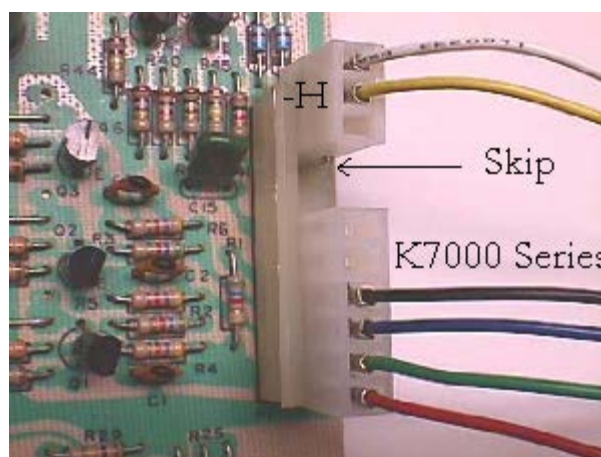


G07 Type Hook-up
Separate Positive Horiz & Vert Syncs
When 1 Single Composite Positive Sync Is
Output From Game Bd Tie Or Loop Syncs

Here's connections for the same 2 boards when using an Electrohome G07 monitor.



There are exceptions to everything & the Wells-Gardner K7000... along with some Hantarex monitors & quite a few of the newer imports... only require one feed of a composite sync output bd such as the Pac-Man, hooked up to the negative horizontal input post with no signal at all on the vertical sync post! In fact, hooking up the composite sync to the vertical post will nearly always cause your pic to jump, jiggle or otherwise mess up!



Rather than pull a wire out or snip it, I have always just set the connector over the end of the header by one position as pic'd above when hooking up a Pac or JAMMA game to the K7000.

Many of these newer monitors that only require one feed post will not achieve vertical deflection, horizontal deflection or any deflection in some, without the sync signal being hooked up, i.e., the monitor is not operable without sync being applied!

Always be sure to resolder the header posts paying special attention to the ground post because, as with everything, a good solid ground is essential to proper operation! Utilizing the ground next to the blue video makes for greater versatility over the ground provided for in the sync connector. As you can see above, with the K7000, it would actually be a hindrance to have a ground in the sync connector.

Trouble shooting your video/sync wiring is fairly easy by using an ohmmeter to measure continuity of each line right from the game bd to the monitor header post it terminates at. Many times a color or sync signal will be lost right at the game bd as it leaves or right in the housing at the monitor end, by a poor pin connection, or by a pin that is only holding on by the insulation & not the wire. In some OEM wiring you'll find that they went through a break plug before arriving at the monitor giving you a few more connections that can go bad by corrosion or wire breaks. I started off using break plugs in the video/sync lines during production of new games, but it didn't take me long to realize this is one place that really doesn't need one & can play mind games with you when intermittent.... well.... as do all intermittent problems!

Well... the sun is up, my eyes are closing & my mind is wandering, so I think I am finished with sync... at least for now :-)
Hopefully, this will be an eyeopener for some :-)

Happy Gaming.....

TB Test Fixture

by Bob Roberts

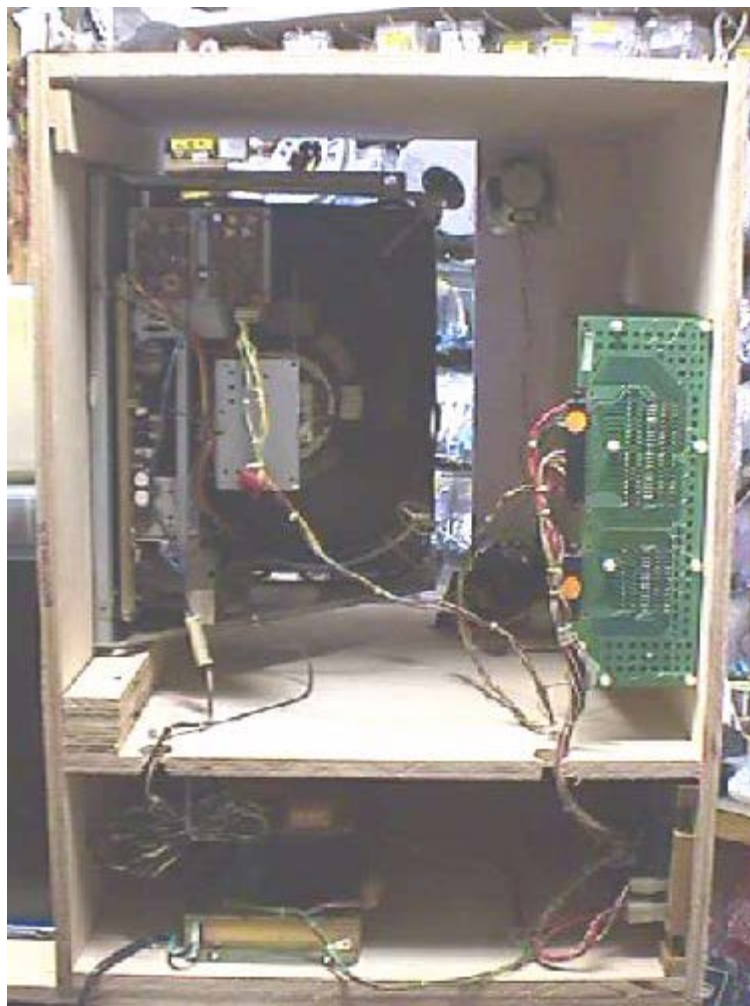
I'm often asked how I can game test trackball units since I don't have any games here. Well... I can test them on any of my jigs, with a scope or other test equipment, but that it not under actual game circumstances... as correctly pointed out to me. To achieve 100% game tested results I picked up an old flood damaged Millipede back in 97 & used it as-was for a couple years. By 2000 it was taking up too much room, so I pulled it out of the cab & built a box for it that I could sit on one of our rollway tables freeing up 4 sq ft of floor space. For the last 6 years the TB units have been "game" tested on this 100% OEM wired game without an OEM cab.... so that's how I do it.



The screws protruding on the upper left side are used to give us expanded space for hanging harnesses... all space has to be utilized here in some form or another. It wasn't meant to be played in it's present state, but with teenage grandsons you know the game is played almost as well as it would be with a control panel :-)



I did rebuild the monitor upon moving it into it's new home & I did put it on tracks to make it easy to remove or replace.



All original wiring with the 2 speakers mounted up front & separated. The PCBs are mounted complete in their original cage on the right wall.



The A/R bd is mounted in tracks for easy removal and to make it easy to test unknown A/R bds.



The AC power supply (transformer assembly) is mounted in the bottom & all the excess wire is cable tied out of the way.



The test switch & volume control panel is mounted to the left for easy access. The grandsons use the old "football" shaped TB unit to play my tester because the optic bds are encased & they are less likely to touch exposed wiring.



While I'm here let me use this to demonstrate a few monitor symptoms. In the pic above the screen is black... dead... but if you see an illuminated screen with no pic, that is called a raster, a FAQ in email. No.... that's not burn-in on the screen... it's a reflection of the parts rack on the opposite wall :-)



Another FAQ... *What's wrong with my monitor that looks like the one above?*

The horizontal frequency is misadjusted & your H-Hold or H-Freq control should bring you back online if your monitor is sync'd properly.



The presentation above is of a lack of horizontal drive... horizontal collapse. More symptoms like this can be found on the [Monitor Orientation Page](#).

Happy Gaming.....

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Test Fixtures

by Bob Roberts

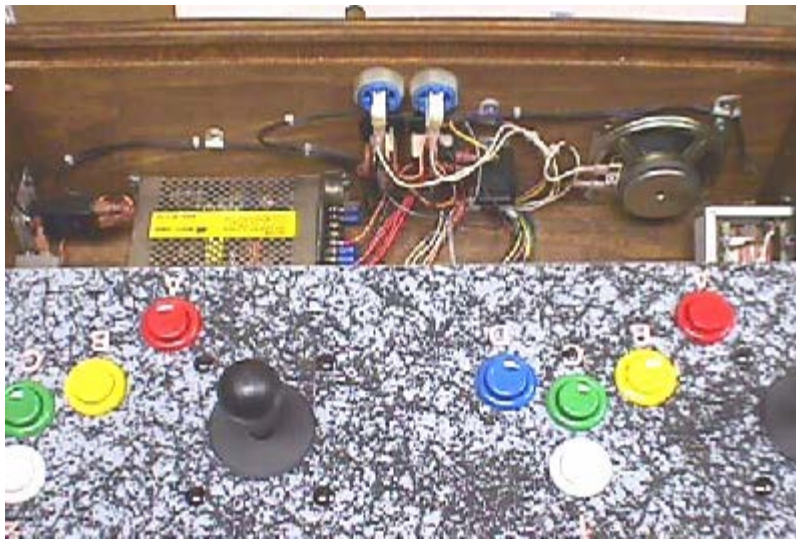
I snapped these pics of this portable test jig to put up on my parts page for sale. As I was making notes on it, I got to thinking that once this was sold, I would be scrapping these pics & notes, and I know there are plenty of collectors that are fast becoming techs...at the least, semi-techs... and figured that this might plant a seedling idea on how to setup a jig for themselves. This is just one of the ways I did it, and I'm sure that each person that looks at it, will form their own ideas as to how they would want to make it, their part placement or even added features that they may want.



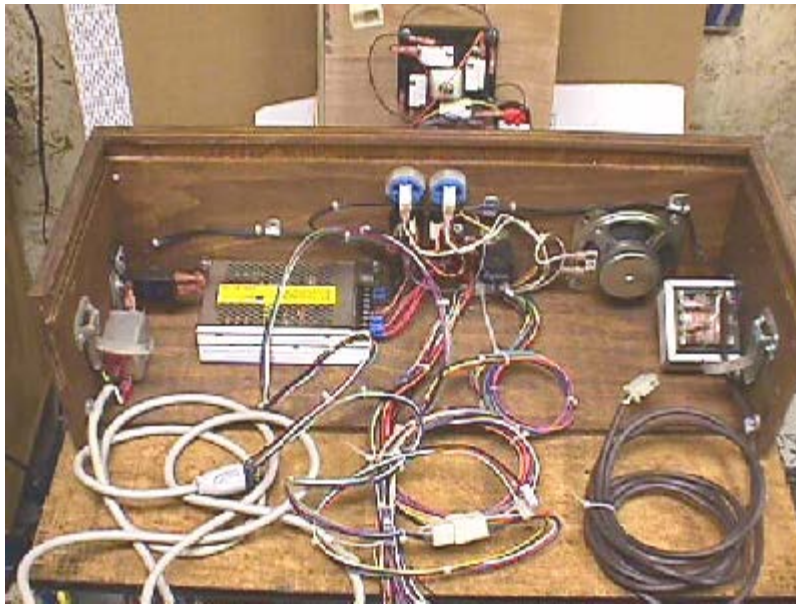
This was one of several portable jigs around the shop, and in fact, this one was wired up for a 3 button game control panel (CP), as it has the later added buttons on the front for Neo-Geo 4 button system from the JAMMA harness. Of course, the CP pic'd is already a new Neo-Geo and the fourth switch line that is now connected to the front buttons could simply move to "D" button, freeing up two extra switches on the front for another purpose. All the new cabs that I built had a unified wiring harness system and CPs, making it very easy to find a trouble spot by simply trying the CP from the game on the jig, or vice versa, if it were an I/O problem of some sort. I even had extension harnesses to plug into a game & work on the CP on the bench, and ops knew that they could swap a CP on location for a quick test, or any other parts for that matter.



Under the 2 blue buttons mounted on the front are the test & coin up buttons, which are both illuminated to allow the tech to know that the jig is on & hot. Simply unlatching & unplugging the 1 & 2 player harnesses from the CP allows for it's complete removal as pic'd below. In the cabs, this made it very easy for an op to change a game on location in a couple of minutes. Plug up the new JAMMA, or JAMMA adapted board, change the CP to correspond & lock it up, moving on to the next location, which might very well receive the PCB & CP just removed from this cab.



This unit is pretty much self contained with the only missing piece being the monitor. This leaves it open to hookup a monitor that might be sitting on the shelf, floor, in a stationary bench jig or any game that happens to be nearby. I see the fast thinkers wondering how it can hookup to one on the shelf or floor already....don't you need an isolation xformer? Yes! That's why all jigs had them installed whether or not they were to be used at a bench station that already had one.



Ok... Let's take a spin around this pic above in a clockwise direction. First we have the 10' AC line cord entering on the left & cable clamped to the sidewall (which easily coils up for storage inside the unit) and it feeds directly into the AC line filter. Exiting from the line filter we enter into a dual purpose push button on/off switch with a self-contained circuit breaker....no fuse to change here....just push off & on to reset. Next we see the 15 amp switching power supply...first in the AC line after it has been switched & fused.

Now, right in the center, the end of the JAMMA harness is cable clamped to the bottom & DC power lines run to the switching PS. The CP lines are terminated in player 1 & player 2 receptacles ready to plug in any game CP. Eight to ten inches from the JAMMA edge connector, the video lines are pulled out and terminated in a Molex receptacle allowing for an extension cable to be added to give the video lines about 7 or 8 feet total length to be added to the length of the JAMMA harness, making any monitor easily accessible. At this point, a bullet connector is added across the HS & VS at the Molex extension plug to be capable of shorting the two lines together for any composite sync pcbs that may be connected to it. On the older pcbs with both syncs needed, the bullet only need be unplugged. I suppose a switch could have been used for this, but bullet connectors are much cheaper :)

The next thing we see (barely) is a little black box on the front wall which happens to be a coin meter, since this was an

important item for an op to have operating properly, it was in all test fixtures. Mounted on the front wall next to it is the speaker & the JAMMA speaker lines simply terminate directly to it with .187 QDs.

Aha....here, mounted on the right sidewall, is the the thing that makes it possible to hookup to monitors on the shelf or floor...the isolation xformer. It is loop fed AC off from the AC line that feeds the power supply, and it has a 10 to 12 foot extension cord leaving the secondary winding. It is cable clamped to the sidewall, and when uncoiled is the means by which a free standing monitor can be powered. The line terminates in an Amp 2 position plug & the reason for this is that the Amp sockets will fit on the Molex power entry pins and the Amp cap pins even though they are "D" polarized.

So we have a test fixture that we can test boards in as well as other things, but how about that monitor that is just sitting around & no one knows, or remembers, if it even works. We seem to be missing something else to test them. How do we produce a video pattern & sync it for this kind of test? Answer: Konami has done that for us.



Well..here's the missing part that can generate a test pattern to try out your unknown monitors, or simply work on one sitting on your bench or kitchen table. This is just an old Konami pcb with the dips set to test. Not only can it generate the patterns & color bars for testing/aligning your monitors, it can test the jig I/O & speaker, or it can do all these same things for your JAMMA game cabinet. A piece of cardboard cut to the size of the PCB is taped on all the way around the edge, so that the board can be placed on any surface while it is fired up during the testing.

Well...there you have it. One way to build your own test fixture incorporating all of your own ideas into it.

Happy Gaming.....

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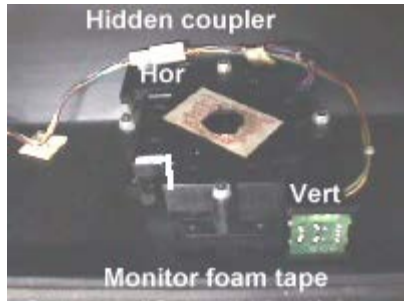
A Look at Trackballs

by Bob Roberts

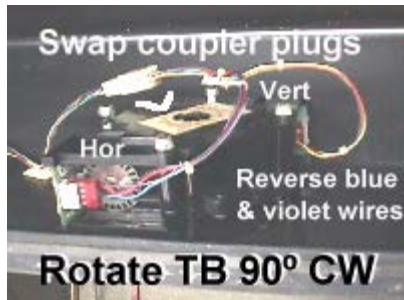
Another troublesome & *confusing* thing for newbies seems to be trackballs. At first I wondered how this could be, but as I started experimenting with the various aspects of this common dilemma, I soon found myself wondering about how all these differences are going to be kept straight. Happs' tech, Danny Wong, had told me that any mods they did conformed to the original trackballs & I took it for gospel until Sunshine (Elio), brought up the fact he was having trouble with a replacement wiring harness not wanting to work properly.

Well, I talked to Danny again & he reassured me that the harness was the same & that I shouldn't have to reverse clk & dir on them as I suggested. In fact, he said if I had to, then they must have gotten a bad batch of harnesses. Maybe so, but from the tests I ran & Elio's input, as well as, input from Scott C. King, I've come to the conclusion that in changing over to SOIC chip & reversing the friction locks on the headers...a very good idea...causes some changes in wiring to be necessary.

I'll start off with the modifications that we made in the field back in the 1980s to preface this a bit. The OEM installation



of the trackball units put the horizontal optical coupling pcb at the very back with the control panel open, and very hard to get at for service... nearly impossible on the Centipede...no room for big hands back there at all. Well, the mod that I used came from an idea that one of my ops gave me. I'd rotate them 90° & swap the plugs on the 2 coupler pcbs, essentially swapping the chores of the 2 boards.



The horizontal now became the vertical & vice versa. This exposed both couplers to the open area of the control panel. One more thing was needed, however. The vertical still operated correctly, but the horizontal tracked in the opposite direction of ball roll....kind of fun to try to remember to roll the opposite way from what you wanted while playing the games, but....it needed to be fixed & the fix is to simply swap the blue wire in the header plug with the violet wire to change direction of roll to match the ball travel. Easily accomplished since MTAs were

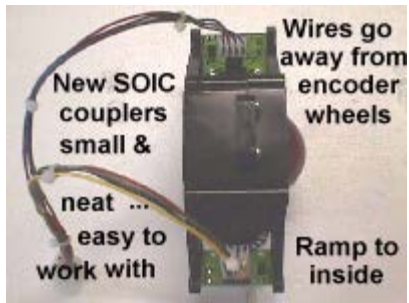


used. All you needed to do was pull the wire out & move it to the other end & push it back in with a jeweler's screwdriver, while off the header, of course.



Moving up to 1999, I find that the new trackball units are being shipped out with the same type modified orientation, even with arrows on them to show direction of mount, however, they did not reverse the blue & violet wires in the harness, so it plugs up from the box with the horizontal tracking in the reverse direction. This is using the assembly with harness straight from the box & mounting as directed. I'd say the best course of action would be to swap the 2 wires, so that the optic encoder pcbs are out in the open area now.....a much better place for them as far as I'm concerned.

Of course, you can elect to take the easy way out & just swap the 2 plugs & disregard the arrow & mount the trackball in the original conventional manner. Now all things should work fine, providing you keep the same optic boards & harness....changing either will have an adverse effect which will require you to do some type of modification. Throughout all of these tests I performed, the one constant in all situations was the ground & 5 volts always remained the same, no matter



what. It is possible to insert the plugs backward to the locking ramps, though, so care should be taken to see that they are not & that they are not sitting over 1 pin to the right or left on the header.

Before going on, let me map out the circuit's path for wiring from the main pcb to the optic pcb using a Centipede as a guide since most are the same basic wiring, just starting from different main pcb edge connector pins.

Main PCB P20	CP Plug P24	TB plug P50	VP51/HP52	Centipede
Pos "Y" + 5 Volts Red	Pos 1	Pos 2	Pos 2 Both	CP
Pos "Z" Ground Black	Pos 6	Pos 1	Pos 3 Both	Control Panel
Pos "U" Horz Dir Blue	Pos 8	Pos 5	Pos 1 Horz	TB
Pos "N" Horz Clk Violet	Pos 9	Pos 6	Pos 4 Horz	TrackBall
Pos "18" Vert Dir Green	Pos 10	Pos 4	Pos 1 Vert	
Pos "P" Vert Clk Yellow	Pos 11	Pos 3	Pos 4 Vert	

Now I'll go into some of the test results when different variations of harnesses & optic pcbs were installed in Centipede, Millipede & Marble Madness.



In the pic on the left is an original TB with harness showing the horizontal pcb connection and on the right is that same pic with a new 1999 harness attached. As you can readily see, the dir & clk are reversed & the wires are still going inward toward the encoder wheel, and you will have to swap the 2 outside wires in order to keep the TB configuration the same. If a new optic pcb were installed, the wiring would be right & would exit the side away from the encoder wheel since



the ramps are reversed on them.



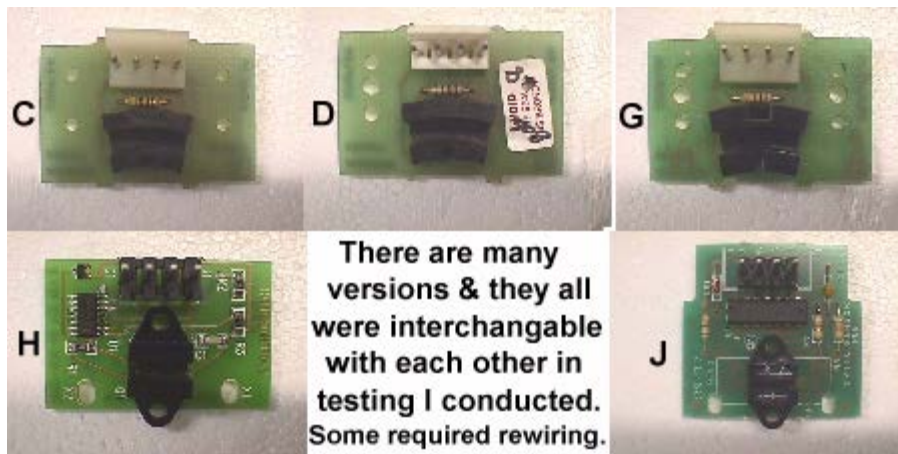
The same thing holds true on the vertical pcb connections as you can see the old trackball with pcb and wiring on the left looks much the same as the horizontal wiring did. In looking at the pic on the right that has the new 1999 harness attached, we see that the outside wires used for clk and dir are reversed once again. If you were to change one of the optic pcbs to the newer type, the wiring would be correct in this conventional mounting using the new harness, but the old pcb remaining would need



to have the outside wires swapped.

Basically, if the combination of new & old optic pcbs along with new or old wiring harnesses are not giving you the proper direction of travel, you only need to swap outer wires to change direction and you never want to try to swap the red & black wires or insert the connector backward.

Here's a look at the evolution of the TB optic boards that I have at my disposal, albeit incomplete, which are also used in steering wheels & other encoding devices.



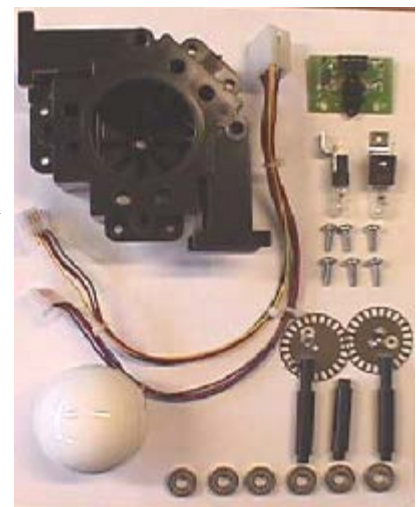
On the left is a pic of a 2¼" trackball unit used in the Missile Command cocktail table(CT) and the new TB roller sets will fit right in these with an idler shaft leftover. The complete TB kit(\$21) will also replace the bearings with a spare bearing left, as well. On the right is a screen shot of the test mode screen depicting travel & color code for the horizontal & vertical optic pcbs' wiring to give you an idea of which set of wires need to be swapped to effect a correctly operating TB.



On the left is pic'd the mini 2¼" trackball & the 3" midi trackball. At the bottom of the pic is a set of worn roller & idler shafts along side a new set. As you can see the ball will drop into the case pretty deep when the shafts are worn. On the right are all the parts used in the trackball from the plastic housing to the screws that hold it together to encoder wheels. The lamp sockets are for illumination of the 3" translucent balls which many have used in place of the solid color balls for the effect it gives to the CP.

Update: May 27, 2001

After much confusion, Happ went back to the conventional mounting method with the arrows made into the plastic cases. Installed this way, your green & yellow wired plug should go onto the optic bd right under the imprint of the arrow & word *monitor* on the case.



If you use a new wire harness with the old optic bds, you'll have to reverse the 2 outside wires...clock & direction...but with the new optic bds... rev "H", the harness is right since the headers are facing in the opposite direction. The new harnesses also use REAL Molex connectors rather than the MTA push in wires... solved a lot of intermittent problems.

As always, all these parts including new & used trackball assemblies can be found on the the [Parts Page](#).

Happy Gaming.....

Trackball Bearings

by Bob Roberts

Does time fly by, or what? I got an email the other day about a new trackball not responding well... veering off to one side & I imagine that it was sluggish, as well. My first thought was that I had just posted the answer to the newsgroup in regards to bearings, but then as I thought more about it, and started a search for it, I began to realize how much time has passed here in cyberspace. I'm thinking like a year ago, but as I go back further & further, I realize that many years have passed since I had time to read or post in the newsgroups, add to these help pages or to work on any of the hundreds of projects on my agenda. I've been a mushroom behind... or under ;)... this keyboard for almost 3 years now, and when I finally located the thread I was looking for, I was shocked to see it was in 1997 followed up by periodic sale posts in 1998 of trackball parts. Wow... 1997/8... I was young then :)

It seems that I have been answering the same questions over & over again in email, keeping them fresh in my mind, but not helping the majority of collectors all at one time. I am going to make an effort to put up more information here in the help pages somehow... I can't for the life of me figure out how some of you provide tech info, maintain websites, read & post to the newsgroups, do your email and fit in family time... let alone holding down full time *real* jobs! Whose playing these games in your collection... I don't see how you have the time to :(

Well, I guess I better get to the trackball info before I fall asleep at this keyboard since it is already three o'clock in the morning.

Trackball bearings come packed in oil and/or rust inhibitors for obvious reasons. Sometimes not all the bearings are as free spinning as they should be. Sometimes if they have been on the shelf awhile, the oil begins to solidify... well, gel up to an almost grease consistency... and sometimes some are just pressed together tighter than others and all these contributing factors mean that the bearings have to be broken in like a new car or a baseball. After installing a new trackball, or new bearings in an old unit, they will sometimes tend to be sluggish, drift to the right or left at the end travel or just basically not respond the way you would want them to. Some of the imports came in dry as a bone, but often with rust already taking a good foothold, and although some worked real well that way, they rusted up much faster due to the hand perspiration & even large spills of liquids on location. Those were the *grindies* and real easy to know that they were in a trackball prior to taking it apart. They would actually wear a flat spot in one of the rollers so that only two rollers would be turning :(

There I go drifting, again, so let me get back on *track* by saying that I read many a way to break in a new set of bearings quickly in the newsgroup, and thought some of them to be a tad bit strange, wondering if they could really work, or the poster was having some fun at others expense :(

Anyway, I'll tell you my strange way of tackling the problem when an op didn't want them to be broken in on location... usually one that was raking in the quarters pretty fast & regular, otherwise it was toss them in there & go! Let me preface this with caution, as I think it might be dangerous, but I have been doing it for many years & never hurt myself, yet, including doing a 100 sets today, so you can use your own judgement.

I take a high speed drill & insert a reaming tool in it. Now since the reaming tool cannot do it's designated job, because the center is riding on ball bearings, it has no choice but to grip the core & spin it ninety miles per hour thus breaking it in. When doing new bearings, I hold them between my thumb & forefinger as in the pic below. NEVER do this with a used bearing!!



I leave it entirely up to you as to your adeptness at handling a drill in this manner, but advise caution.... always respect power tools!

Once these bearings are installed, they need to be oiled & oiled periodically. Never use WD-40 as it gums up rapidly & you will be needing to redo your bearings in short order. Game manufacturers recommend removing the whole TB unit from the control panel, opening it up by removing the 6 screws that hold the case together, and individually oiling each bearing with 2 drops of light-duty oil such as 3-in-one oil every 3 months. Normally, I would say in home use that you may be able to go 6 months between oilings, but as I remember, my wife, her gal friends and my daughters kept Centipede pretty much going around the clock in my own personal home game room, so perhaps they may even need to be oiled more often :)

Now you know that no self-respecting operator is going to be taking his game apart every three months while it is still taking in quarters, so I did find a cheat that worked well for them & I also have always used it in the shop, as well. This product, called Aero Kroil by Kano Laboratories, comes in a spray can making it easy to go in thru the oil ports in the case by simply dropping the control panel & putting a small drop on each bearing. This solvent creeps into openings as small as one millionth of an inch. It dissolves gum, dried grease, oil and removes rust & carbon deposits without attacking the metal. It also provides lubrication & resists weathering. What more could you ask for! Their website is <http://www.kanolabs.com/> if you want to stop by & check it out. Tell them I sent you... maybe I'll get some lagniappe :)

This is probably going to sound wasteful, but what I did on mounted TB units, was to point the Aerokroil into the wastebasket & slightly depress the nozzle which would leave a small droplet on the end of the spray tube that I could put directly on the bearing using a flashlight to guide me. That way I did not have the trouble that ops had of overspraying them getting oil all over the rollers & the ball.... probably much more wasteful.

Here's another use that might please some... I know it has pleased many collectors over the past 4 years, or so... if you have a maxi TB unit & your bearings are rusty, you can do a variation of this method by soaking them in the penetrating oil overnight and then mounting them in a vise & use the drill/reaming tool in short bursts of power at first, to loosen the rusted parts. Once freed, then you can put it on full speed to actually pulverize the rusted particles inside the bearings. Another quick spray of Aerokroil & a few more spins will flush it out & lube it all at the same time. This can also be done if you are trying to save some of those old oddball sized bearings from a Wico unit. These will not be as good as new, but better than nothing at all :(

This reminds me of another repeat question... about interchangeableness [now that's a wordful] of the rollers & bearings. Happ bearings will fit 2¼" & 3" Atari/Happ TB units & the 3" enclosed copies made for Wico & Imperial. The 3" idler [short] roller will work in all the 3" TB units, but the encoder rollers in the other two brand names, while interchangeable with each other, have shorter protruding shafts than Happ's. I suppose if you had plenty of time, you could probably cut the Happ encoder rollers down to a matching size, although you might have to tap the thread a little deeper. The optic pcbs are also interchangeable between these two, but are very different in size & construction compared to the Happ.

Update August 26, 2008

In regards to what I have been saying for many years pertaining to cutting the long 3" Atari roller shafts down to fit the Wico or Imperial trackballs... it has finally been confirmed possible by Adam Pletcher. Here's what he had to say, "So it turns out, if you cut off 1/8" or so from the two Atari rollers with a dremel they fit the import TB units perfectly. The wheel screws even still fit. I just marked it next to the old one and cut." That should help many of you & my guess is that you could probably accomplish it with a hacksaw if you don't own a Dremel, as well.

IMHO there is nothing that can touch the Happ TB units... always have had parts available & have been very dependable with periodic upgrades to meet current times.

Happy Gaming.....

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- Illuminating A 2¼" Trackball -

This one has been topping the charts for quite sometime, so it's earned a spot up here.

- How do I light up my mini trackball unit?

Well... this is how I do it... right or wrong! First you disassemble the unit & since you only want to be toting the case bottom around for modification, I'd suggest you leave the harness on the optic bds with the case top in the positions they go in. This should be of help when you go to put it back together, physically noting where they belong, preventing you from mixing up vertical & horizontal wiring.

Next would be to wash up the bottom case with dish soap & warm water, rinse & dry, & you're ready to drill. The center hole needs to be enlarged to 3/8" to allow enough light through. I use a step drill for this, but I imagine you could use a std 3/8" bit utilizing the existing hole as a pilot. Now take your lamp/lamp holder & align it over the hole. If you align the filament inside the bulb with the center of the hole it'll give you a more uniform look. Keeping this alignment you can pivot the holder to a good location for fastening. If you are going to drill a pilot hole make sure that it will not interfere with any necessary components on the inside, e.g., don't drill the hole where the screw will go right up through under a bearing :- (I always chose not to drill the pilot, but to use one of the slots to either side of the case for fastening. The screw makes it's own threads as it goes. I've never cracked a case... hmmm, sounds like something that Perry Mason would never say :-)... in doing it this way, but I have wondered if things were going to go smoothly many times. I was afraid it would crack the first time I tried this on an old broken case, but that was not the case, proving once again that you just never know till you try something new.



K.... reassemble the TB unit & mount it back just the way you found it!!

Note: DO NOT overtighten the screws that hold the case together! They only need to be snugged up hand tight & trying to reef them will destroy them now, or later.

Now we need some power to illuminate this lamp. If you take a couple pieces of 20ga wire, 1 black for ground & 1 orange for 10-12VDC, about 10" long, you can fasten them in no particular polarity, across the 2 terminals of the lamp holder. Add a Molex 2 position connector to the other end & then cable tie it to the TB harness. This keeps it contained with less risk of it getting entangled in the moving parts of the TB. Note: If you decide to use a 6 volt lamp you can swap in a red 20ga wire for the orange above. Keeping power lines color coded is not only neat & useful, but it might save you, or some tech in the future, a whole lot of guess work.

Now you'll have to continue your wiring from the other side of your newly installed connector to whatever power source you have selected. I recommend that the 5VDC logic lines not be tapped into. Why add the extra load when you have such a vast selection of sources at hand. To keep lines to a minimum in most cabs you have your control panel & coin door break connectors in the same general area, if not side by side, making it easy to tap into coin door power lines. Obviously, your black ground wire can tap in anyplace that has a logic ground line passing by. As for the orange wire,

most coin doors have a drop for 10 to 12VDC to provide power for coin lockouts, if used. Sometimes the coin meters are driven by 12VDC, also.

Oh... for the red wire people that are thinking if they can't use the 5VDC logic power, where do they derive their power from... many coin doors have 6.3VAC power available for coin rejector illumination, whether or not it is used, it can usually be found in the coin door break plug... cab side only if not already in use. Always consult your game's manual to see what power is available to you in your particular cab.

Of course, if this is going into a cab of your own design, you can provide the power directly from your power supply up to the area of your control panel. You'll still need to use a break connector just prior to the TB.

- In this wedge lamp holder use a #555 lamp with 5 to 7 volt source, or a #161 lamp with a 10 to 12 volt source. Make sure you use a translucent ball lest this be all for naught;-)

Ready to smoke test it.... good luck & Happy Gaming....

PostScript: I mentioned that I used a broken case to experiment with years ago, and I should mention how many of these cases were prematurely sent to the junk pile :-(It seems ops.... and now hobbyist... frequently wanted to use a no-no shortcut to testing their optic bds in these units by prying them up at the case "T" that holds them in place, enough to slip the bds out :-(Don't be caught caseless because of this needless shortcut... spend some quality time with your TB & it will be around for many years to come :-)

- Trackball Trouble -

Symptom:

No movement up or down!

Power off... remove optic connector with blue & violet wires for clock and direction and let it hang free. Now take the optic connector with green & yellow wires & move it to the now empty optic bd connector. Power on ... move trackball for left & right movement.

Results:

A. You can move up & down now by rolling the ball side to side.

Examine the first optic bd for a cold or open solder joint & replace if it appears to be okay as you most likely have a bad optic sensor.

B. You still cannot move in any direction.

You need to examine the connectors & wiring all the way back to the main PCB edge connector. If you find no breaks/opens in the wiring then chances are that you have a problem on board.

Symptom:

No movement left or right!

Power off... remove optic connector with green & yellow wires for clock and direction and let it hang free. Now take the optic connector with blue & violet wires & move it to the now empty optic bd connector. Power on ... move trackball for up & down movement.

Results:

A. You can move side to side now by rolling the ball up & down.

Examine the first optic bd for a cold or open solder joint & replace if it appears to be okay as you most likely have a bad optic sensor.

B. You still cannot move in any direction.

You need to examine the connectors & wiring all the way back to the main PCB edge connector. If you find no breaks/opens in the wiring then chances are that you have a problem on board.

Happy Gaming.....

Transformers

by Bob Roberts

I recently responded to a post in RGVAC in regards to using a Nintendo type monitor in a standard game. Rather than tell you the details, let me go hijack that vehicle of communication & place here for easy reference.

Gary Vitagliano wrote:(In re: using 100VAC monitor with 120VAC applied)

>

> I have a Nintendo monitor in my Galaga and its been on location for a
> year with no problems.Come to think of it it VERY hot inside the cab.

Bob Roberts wrote:

To cool it down, Midway transformers are output selectable to 100 VAC...
and those monitors look great in there :)

David Choi wrote:

Technically, they are INPUT voltage selectable, not output ;)

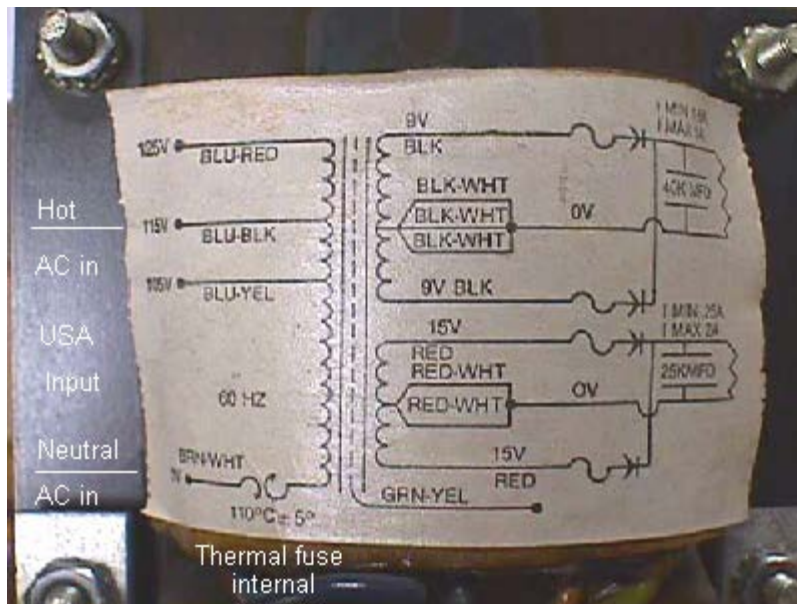
But since $V_{out}(t) = k V_{in}(t)$, you **could** consider it both ways

Let me address the reasoning behind saying that it was output selectable (if I had a spell checker I believe I would set off an alarm on this word) before saying anything else about transformers. I thought anyone would wonder about this & ask before attempting any changes to their wiring, but since David has used the word input, I thought I had better clarify this before someone burns up a monitor, or perhaps, even a game board.

The taps are indeed on the input, or primary side of the transformers, and my fear was that someone might move their "input tap" to 100VAC on the primary side. Doing so, will raise the isolated secondary output to the monitor...which only needs 100VAC already...to approximately 145VAC. On some other games with multiple secondaries, it could increase the pcb input voltages to as high as 40VAC-CT & 30VAC-CT on secondary windings, while on yet other secondary windings...12VAC or 6.3VAC for coin door lamps will shoot up to about 1.5 times the needed volts. Brightly lit, to say the least, and popcorn is more likely :(

Some of the transformers only have an option of 115 or 220 primary input and could not be changed, anyway, other than in the correct direction, but with too little output...half of the stated outputs...after moving to the 220 tap.

What I had suggested was using the transformer the wrong way to obtain the correct results. Let me paste a pic of a typical xformer here to refer to:



In the pic the AC line input is shown in the correct position for USA power which is often referred to as 110,115 or 120, depending on whose schematic you are reading or in this case, the layout right on the transformer itself. Now if we move our known 115VAC hot wire to the 125VAC input tap above it, we are supplying an input potential that is lower than the 125 volts needed to produce the required results on the secondary winding, ergo, the secondary windings are also outputting lower voltages.

This is the desired effect for the Galaga in question. Although the xformer in the pic does not have an added 1:1 isolation output, let's assume it does for purposes of comparison. When the line voltage is applied to the proper tap, you would have 115VAC isolated to the monitor. After moving the hot wire to the 125V tap, your results would be 100VAC...+ or - a volt or two...and the other secondary voltages, would also be reduced to dual 7V CT & 12V CT outputs...still plenty to rectify & supply regulator inputs...so the game should function with the correct input voltages to the pcb & to the 100VAC Nintendo monitor.

This xformer has a 105VAC hot tap and if you move your hot to it, you will be placing the undesirable voltages on everything connected to the secondary windings since you will be supplying it with more voltage than the tap requires.

I'm trying to keep the technical jargon down, the formulae out and get this into the simplest form, as I realize that the majority of readers are collectors who are by day, doctors, nurses, dentists, truckdrivers, mail carriers, programmers, engineers...well y'all read everyone's occupations in the RGVAC thread awhile back, so I'm sure you know the rest.

Now...onto what I found on Dejanews...a quiz on xformers by Brien King. Alrighty then...it's been a hundred years since college, but I'll give it a try in basic terms...especially after reading some of the answers :(I'm sure things have not changed that much over the years.

1) What does the size of the transformer mean? Does bigger mean more amps, volts, etc...?

The physical size doesn't really mean a thing to our applications, other than that they are most likely a multiple output xformer with a host of input taps for line in operating voltage if they are huge. Some of the very large xformers have less than a 1 Amp isolated output to run the monitor, while some of the medium sized ones have 1.5 amp to run the monitor. The difference is in the number of coils, called windings, and in the gauge of wire (determines the amps of that winding) used to wind these coils that are used to obtain other usable sources of AC power.

If you were to line up 5 1:1 isolation transformers, then the larger one of all of them, would most likely be the highest amperage one, all things considered, but not necessarily so. The volts have no correlation to size. You have very small xformers in switching PSs & very large ones in Taito's vid games, but they both require an input of 115VAC & output the necessary voltage & amperage to the circuits they operate. Some of the secondary windings on the very large xformers only output 6.3 VAC at around 500 milliamps...just enough to operate a couple of coin door lamps.

In other fields, where a 230 volt 10 amp output might be required, or some other heavy duty output, you will see a greatly enlarged & heavy xformer. Just isn't applicable to vid game operation.

2) Whats the difference in the number of inputs and outputs?

Multiple primary windings are indeed used in vids. One example would be the WMs series where they use a jumper to feed 115VAC to each of twin windings. By replacing the jumper with a different configuration, the twin windings are joined together to accept a 230VAC input.

Atari offers another twin winding primary that has input selection via a jumper plug. I've seen many come into the shop with a small pic in the center, or not working at all...sometimes with a lot of damage...due to an op changing the jumper plug while attempting to repair something else. I would assume a blown fuse, which would disable the machine & might cause him to try another of the jumpers in hopes of getting it going....once the fuse was found & replaced, he'd be left with the wrong jumper plug & assume it was the fault that caused the fuse to blow. In the US, the jumper plug should be the one with yellow wires which route the incoming AC line to operate the xformer at 120VAC. The other option plugs usually cable tied together are violet/100V.....blue/220V.....brown/240V.

The number of outputs are determined by the number of secondary windings in the transformer...some with a CT (center tap to divide the whole voltage, i.e., 30VAC-CT would be 2 15VAC in respect to the center tap or 30VAC from one end to the other) that is not used, adding leftover taps/terminals. Typically, you will find 2 taps for 115V isolation to monitor, 2 in the neighborhood of 15v for rectifying down to a 12VDC for the sound circuits, generally, and possibly 4 at about 7VAC.....one pair for -5VDC feed & one pair for +5VDC feed. Some go on to add a winding for 6.3VAC to directly feed the coin door lamps, while still others add a winding to operate coin lockout coils on the coin door or other circuits within the game. All in all, you can add up a whole parcel of terminals protruding from that huge hunk of metal....all at the whim of the designer.

3) Is it possible to get them backwards? I.e. reverse the input/output sides.

It sure is! Each and every tap has it's own unique number to identify which winding it is inside the xformer. Your xformer should have the number terminal it is marked right on it. If not, they usually have color coded wires & you'll need a schematic to identify them, especially with the big multiple ones, which require the external jumper plugs to route wiring of the internal windings. On smaller xformers it is usually pretty easy to find the input...most often on one side...and the outputs coming from the opposite side. These usually have 6" wire leads exiting & are color coded & grouped together so that you could measure the voltages to determine the output values. Keep in mind, that if you do not know what the xformer is used in, you'll not have a way to determine it's amps by this method.

Single unit monitor isolation xformers are easy to determine the primary winding from the secondary winding via an ohmmeter. Although they are a 1:1 ratio, and both windings should measure equally, in the real world, the primary will be as much as 1 ohm less than the secondary going up to the monitor. 5 to 6 ohms primary....6 to 7 ohms secondary. The primary winding is almost exclusively on the bottom, with the secondary to the top on 1:1 ratio xformers, but on a step-down isolation xformer, like the 1.2:1 100VAC output, it is just the opposite, although the 1.2:1 can be reversed to supply a 115VAC monitor with the proper voltage from a Nintendo 100VAC output xformer. This should only be done with a single unit isolation xformer as the windings will be made up from the same gauge wire, as opposed to a winding that will only handle 250ma, and there are no other secondary windings to contend with.

Hooking up the AC line input to a 6.3VAC output could prove to be quite a spectacular show. More food for thought when attempting a guess at what a pair of terminals are used for.

4) Is there a difference between using the top side of the transformer and bottom side? In the Williams games they have Isolation Transformers that have Inputs and Outputs on both the top and bottom of the transformer. Which should be used in which cases or does it even really matter?

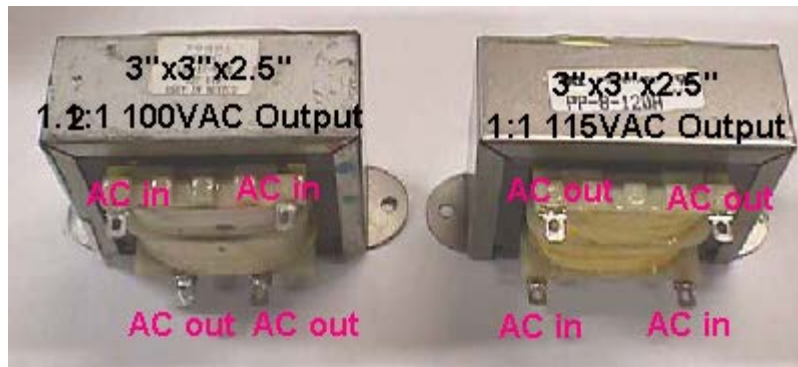
The top side & bottom are not relative in & of themselves. These are simply the best exit points for the various coils inside the xformer. Each winding will generally be located together, e.g., 7 & 8 will constitute a coil, or it could be 7 &

9 with 8 being an unused CT terminal.

I've accidentally covered this in Qs 1 thru 3, but the isolated output in WMs does have 2 outputs...1 for the monitor & 1 for the marquee lamp...that are electrically the same point at the xformer, terminals 9 & 10, however, at the connector 6J1 they divide and 9 & 11 are electrically the same & 10 & 12 are electrically the same, with 9 & 10 being the marquee lamp, and 11 & 12 being the monitor. You can swap them, as long as the pairs are kept together. Again, everything else does really matter.

5) Are ALL the outputs isolated from their inputs or are some just pass through?

There are many types of transformers & the ones that are used in the vid games are isolated step-down, step-up & true "isolation (1:1)". Since HS, many moons ago, and my first electronics instructor, Ben Woods, I've always heard & classified myself, all isolated transformers as isolation transformers by virtue of their construction...all little coils to themselves...depending on induction of AC (alternating current) at the primary taps to produce an output from them. I say true isolation above, as the term was used to signify a 1:1 transformer whereby you got out, what you put in, but today there are isolation xformers marketed with ratios from 1.3:1 to 1:1.3, which simply means that they slightly step up or down the resulting output to meet the circuit's requirements.....be it monitor, power supply or some equipment used in a hospital.



Autotransformers are ones in which one of the primary input winding terminals is also used as a secondary tie point. I just read that my bud, John, seemed to think that the WMs xformer was a type of autoxformer, but since it does not share a primary & secondary terminal & is totally isolated, I would have to disagree with that, and I don't believe that any were ever used in the construction of vid games. The most common use of these today, at least as it pertains to this field, is in the variable transformers that are sold pretty much nationwide as a piece of test equipment best used in finding circuit shorts, and one must remember to also use an isolation xformer in conjunction with these....especially on monitor work.



I just took a look for any posts I might have missed and came up with Dick Merryman's post...excellent job, although in his added comments he missed a trick question that pertains to newer vids...not that I haven't made any errors here, as matter of fact, with only one eye open at this point, you may be missing every other letter I typed :)

Dick Merryman wrote:

- Are any of the outputs of the isolation transformer DC?? Not by a long shot. Transformers work only on AC.

This used to be true up until about the turn of this decade, at least that is when I got my first of many tricky little xformers. It seems that someone has gotten the bright idea of installing diodes inside of the metal cased transformers, sandwiching them in between 2 layers of insulating fish paper. The first one I got in was in a gaming vid & I immediately jumped to the conclusion that I had an open secondary winding....no AC out....wrong, but right. There was no AC out, but there was a DC output. I hope they haven't thought about utilizing all this surface mount technology to a point where they can house an entire power supply inside a xformer shielding case, sandwiched in between a couple insulators.

Happy Gaming.....

Isolation transformers can be found on the [Parts Page](#).

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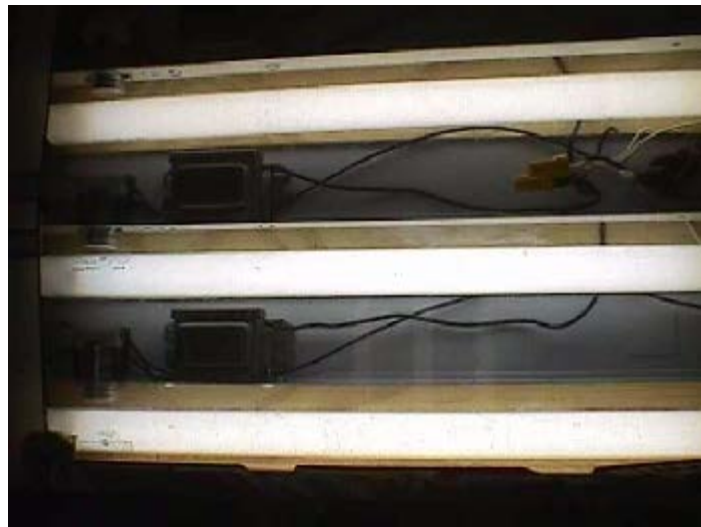
Midway 90412 Power Supply

By Bob Roberts

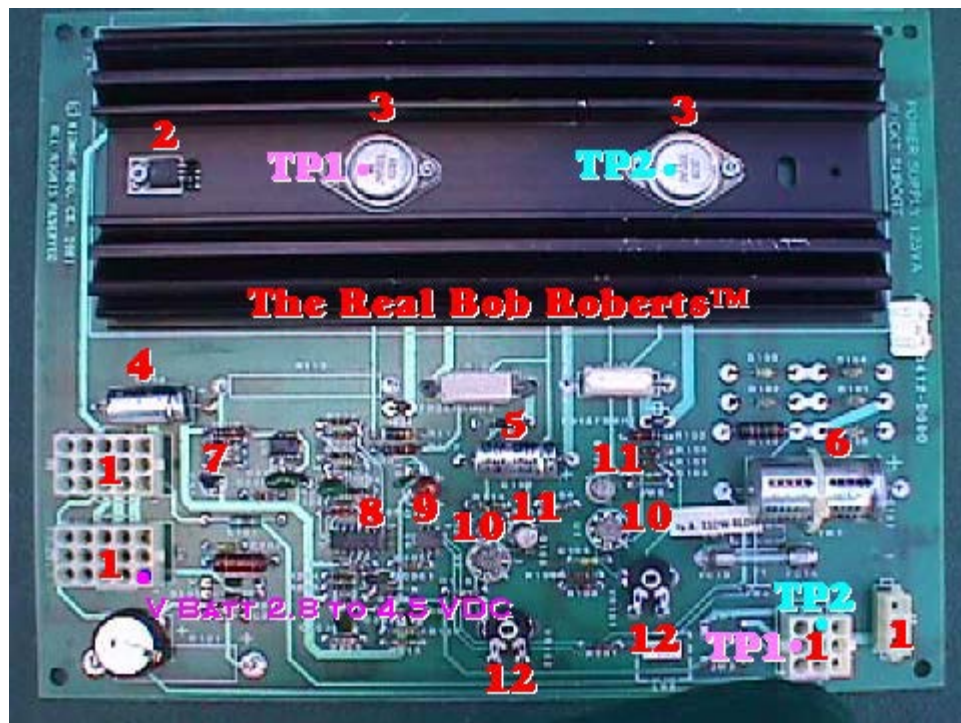
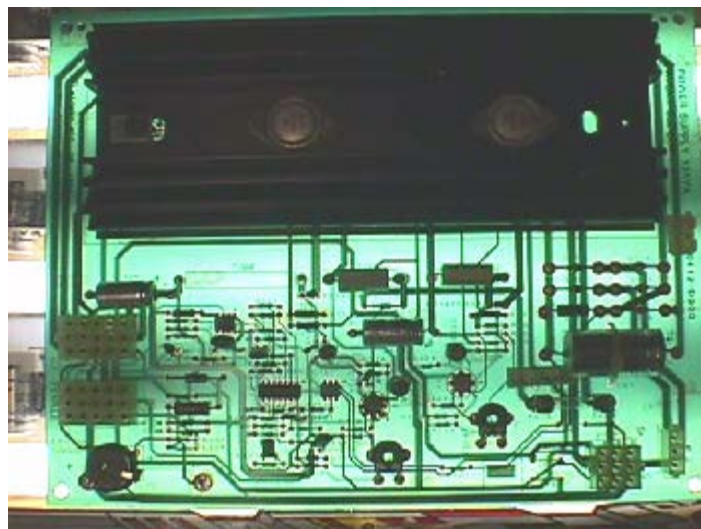
The Midway 90412 125VA linear power supply is one of the better linears around... unlike it's predecessor the 90411/414... and it's only drawback is the fact that the battery was mounted on board. Well, they knew by then that the ni-cad batteries were destroying CPU boards left & right, hence the new location & new prey for the leaky battery's acid! These power supplies are well worth saving, IMHO... and quite a few collectors have been asking for repair kits for them for over 4 years... so I guess others share my sentiments in this matter, as well. In 1997 the cost of all the components to make a shotgun repair was around \$35...a tad steep...driving people to seek alternative power sources. In repairing over 50 of them that I had in the warehouse in preparation for selling them, I saw that a vast majority of them only needed the 4 Amp socket/pin housings replaced, so I put together kits to replace them & their mating plugs. I know this did not save all of the 90412s and I have been price checking periodically on the components needed, while still fielding email in regards to making up repair kits.

Well... the day has come! I've bought in all the parts needed through five different sources, although some did have all the components, but were so cost prohibitive that they far exceeded the multiple shipping costs. I think if you own a Tron, Spy Hunter or other Midway game that uses the 90412, you'd be well served in restoring this linear. Now I don't mean that you should take one that is so eaten by acid that you would need to bead blast it before installing the new components, but it is a shame that so many salvageable power supplies are collecting dust, or worse yet, laying in a graveyard somewhere. If you want to revive one via bead blasting... go for it by all means... but it isn't practical for everyone.

Yes... I'm rambling on giving the pic time to load :) It's a pic of the power supply that I have numbered for easy location of the components. I took a pic of another helpful device for your shop, garage... living room table while the spouse is away;)... and that is a light box. It can be used to see through the PCBs as needed in this case to see that corrosion had not crept up into the pins & sockets, but it has many other uses in checking solder joints, trying to follow traces above & below the board when repairing them, while clearing solder pads, so that you see they are, in fact cleared, to name a few of it's many uses.



These are very easy to throw together. All you need is a piece of plywood to mount 3 or 4 flourescent fixtures on and then add a couple pieces of strapping on two sides to mount a piece of clear plexi over them. Makes a dramatic difference in the way you see a PCB as pic'd below. I guess the pic of the 90412 is surely loaded by now :)



Ken Colangelo doctored up this pic a little better [here](#).

Here's the pic showing the parts placement by numbers. It should make locating the components relatively easy cutting the repair time down to a minimum. I'll put the parts list that comes with the kit in here, as well.

Midway 90412 Power Supply

- 1. 4 Solder Tail Sockets
 - J5 15 position with pins
 - J4 15 position with sockets
 - J3 9 position with pins
 - J6 3 position with pins
- 2. TIP31 Transistor.....Q104
- 3. 2N5301 Transistor.....Q101/Q103 Replace with 2N3772
- 4. 470µf 25v Axial cap.....C106
- 5. 470µf 25v Axial cap.....C102
- 6. 4700µf 25v Axial cap.....C101
- 7. 2N4401 Transistor.....Q201
- 8. LM3900N.....U3

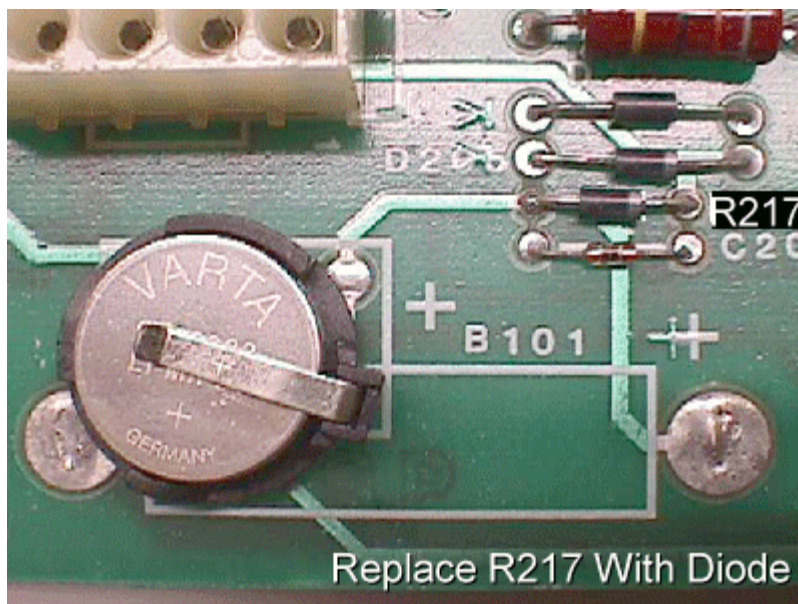
- 9. 4N28.....U4
- 10. LM305U1/U2
- 11. 2N2905 Transistor.....Q102/Q105
- 12. 100 ohm pot.....VR101/VR102

This kit contains the 19 components listed above to shotgun repair the Midway A082-90412-C000 as found in such arcade games as Tron (1982) and Spy Hunter (1984).

Care should be taken to insure that caps are installed with the proper polarity & that connectors are replaced in exactly the same way as you remove them. The PC board has the polarity silked onto it, as well as all the rest of the parts along with the number 1 to indicate pin 1 of the socket housings.

If you have a multimeter I would suggest that you measure ohms from Q103 metal case to J3 socket position 8 to make sure you have continuity... dead short... and from Q101 metal case to J3 position 6, again looking for close to zero ohms, before reinstalling the power supply in your game.

Adding fresh new solder to any joints that you are going to desolder will aid greatly in the removal of the old solder since most of the PCBs have battery acid present from the board mounted ni-cad battery. To prevent further damage to the PCB I would change the battery system, as well. You can do this several ways, but I would stick to the trouble free methods of either installing a new ni-cad & mounting it off board via a married pair of speaker wire which has a stripe on the ground side to help you identify it, or install a lithium battery & holder onboard & change R217 resistor to a 1N4007 blocking diode... colored band away from battery. " AA" batteries & holder designed for portable radios & such, are not recommended for use in arcade games. If you must use them a containment holder should be built that holds them tightly in place... the same way they are secured in radios, alarms, or just about any apparatus whereby you must remove a screw in the cover to get to them.



Onboard socket housings may appear to have nice clean pins in them, but you can usually look at them with a magnifying glass & tell right away if you can skate on replacing them. If you see ANY signs of green discoloration, especially in the center openings of either the pins or sockets, you should replace that housing. Since it is no great feat to install & remove this power supply, you may want to try it before changing U1 & U2 which can be a little tricky to replace if your skills are not quite what they should be. If it works fine with just the other components replaced, I'd skip this at your option, because, although these regulators often look like an ugly gob of corrosion, they usually work just fine... none the worse for wear. If you do change them, note the index tab that protrudes from the top marks the last pin (8) & count starts with the next pin going in a counterclockwise direction.

Happy Gaming.....

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Universal Joystick

by Bob Roberts

A lot of you have asked how this stick works, so I'm going to give it a quick breakdown here that should help you decide if they are for you, or not.



This stick easily mounts in a button hole on your control panel. Since it is short...2 1/2" rise from panel... it will fit in those tight places such as on cocktail tables & countertops where you don't want the stick blocking the screen action. It is extremely responsive. They tell me it is great when used on any of the Pac cabinets & doesn't require an adaptor plate. It will mount to a wood control panel as easily as it does to a metal control panel.



A simple quarter turn separates the switch body.



Remove the washer & nut & you're ready to simply drop the handle into your button hole... 1 1/8" diameter... and replace the washer & nut. After the the handle is secure you just replace the switch body with that simple quarter turn to lock it back onto the handle.



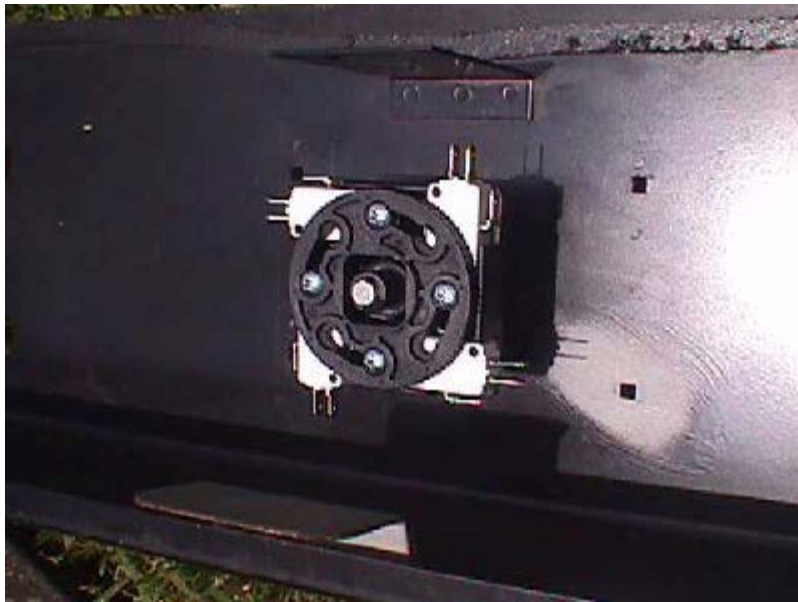
Another great feature is that it is either 4-way or 8-way by simply turning the restrictor plate on the bottom to your needs. It can be locked in place by tightening the screws or if the screws are in the raised position you can swap back & forth at will.



Here's a close-up of the restrictor plate. You can see that this too, is just a slight turn to swap between the two options.



K... I went out back & found this old Ms Pac CP to get a better idea of how it looks on a control panel.



Happy Gaming...

Using A Radial Cap To Replace An Axial Cap

How do I use a radial cap in place of an axial?

It says on your cap listing that several of the caps "can easily replace axial" How?

I read these Q's so often that I decided to put a quick link here to point to another of my pages.



[See one way it's done here.](#)

Update 6/08:

Now the question has become why do I need to use radial caps?

High value axial caps are obsolete & have not been available for well over 10 years now. I hear people tell me they've found a source for these old dinosaurs every once in awhile & the first thing I ask them for is the coded numbers on them & 2 easy ones that have popped up a couple times are 8150 & 8610. These are straight forward dates as found on many electronic components & are the year & week of manufacture, i.e., the first one was made in the 50th week of 1981 making it 26 years old, give or take a day or two. The second one then becomes easier to see that it is newer & was made in the 10th week of 1986, but still 22 years old, which means that it could be older than the one you are replacing in your classic & quite possibly in a lower capacitance state. This would account for the many times I've heard that 1... it didn't work as well as it did before I changed the cap... and 2... it worked fine for a few hours-days-weeks & then crapped out.

Another common Q is how else can I do this substitution?

You can find a CG (Computer Grade) cap at a comparable value & add a couple wires to feed to your PCB or the better way is to use the newer, common, less expensive & more likely to be fresher, snap in capacitors of a comparable value. The wires need to be soldered to the snap in terminals & fed to the PCB. In both these cases you can look for new contact points, or even make new ones if need be, to accommodate both the new wires on one end or the other, i.e., not fishing a wire to the opposite end of the new cap. This will probably be easier with pic'd examples, so let me pick on Williams' 18,000uf20v-25v-30v axial caps.

Williams 18K20VA Thirty Years Ago

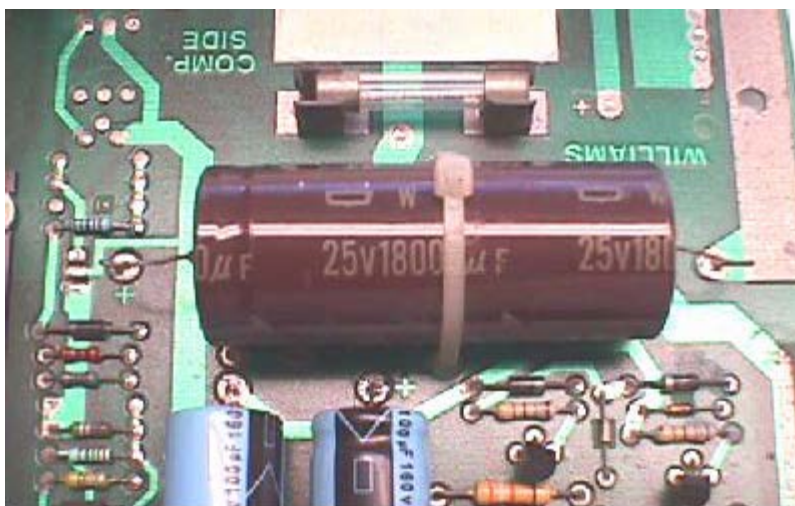


3 Inches Long & 1 3/8" in Diameter

And... here's another even larger than the one above:

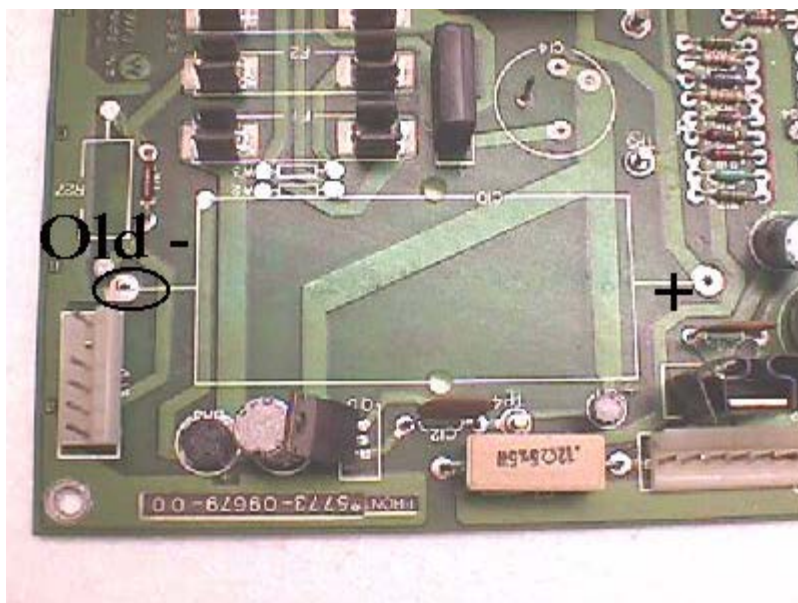


And... then they got smaller before being phased out:

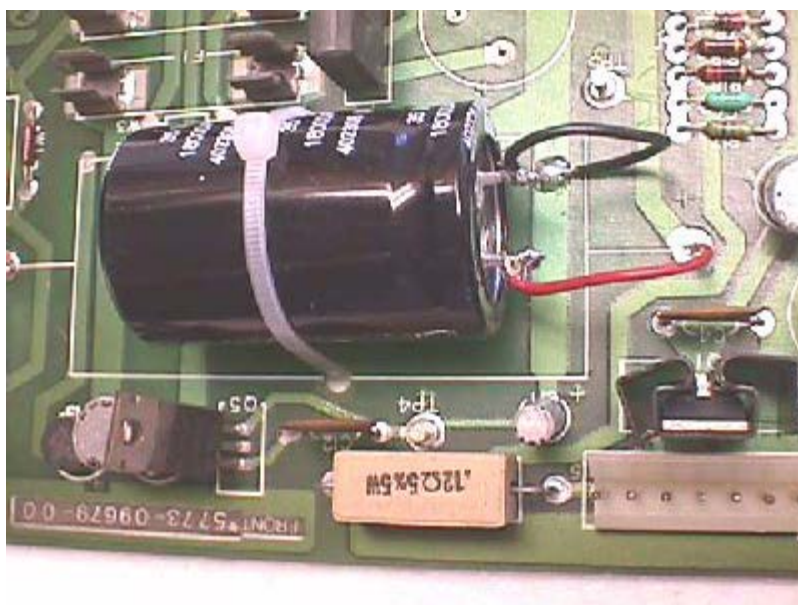


Twenty Years Ago - 2 3/8"x1"D

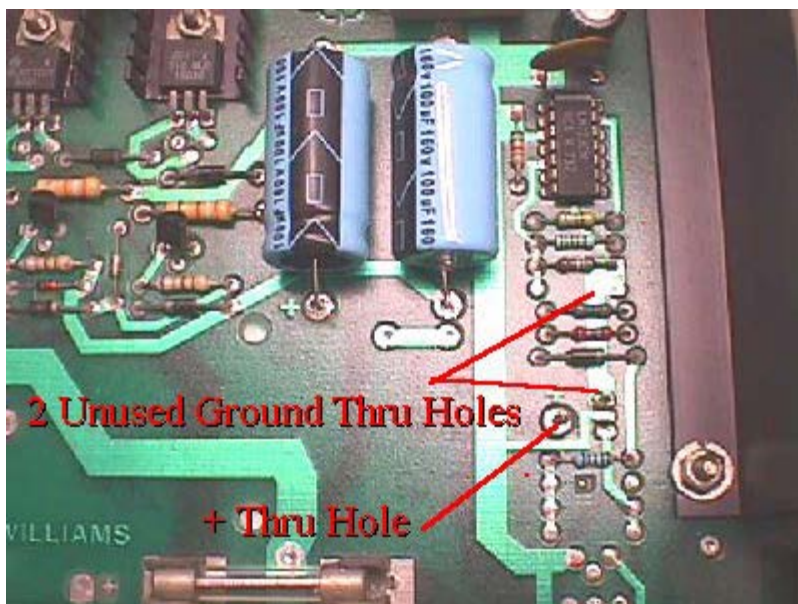
Let's start with the taxi cab yellow axial by removing it from the PCB.



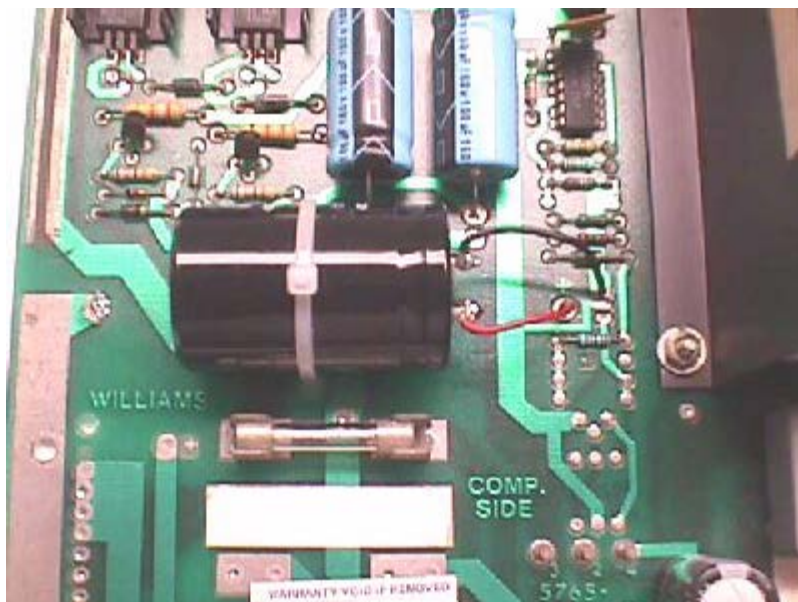
Now you can see above that there is no close tie to the - side (ground) to wire in the + side, but looking at the + thru hole, even though there are no vacant ground thru holes, there is a wide ground strap trace running right past it. You can drill your own thru hole since there is nothing in the way on the flip side, but it's easier to just scrape & tin a spot on the trace itself. Either way, you won't need to run a wire all the way back to the original - thru hole keeping both new wires to one side.



Finish look for the quick replacement with a fresh 18,000uf35v radial of 1 3/4" length by 1 1/8" diameter. Fill in the old - thru hole & you're good to go for another 20 years. Of course, you can still run your ground wire back to the original thru hole if you wanted to, or you could drill a new one in the area where it is tapped in on the pic above.



This board has the option of 2 nearby ground thru holes to use on the + end of the cap.



Well, considering that back in the day we had to pay \$12 to \$20 for those dinosaur capacitors, depending on where you bought them, these new \$6 investments sound pretty good to these old ears & kind of makes me want to jump back into the thick of things....wait.... let me think...not really :-)

Update June 2009:

Replacing even larger caps as found on the Midway 90421 & 90427 linear power supplies addressed here:

[Stack'em Up](#)

Happy Gaming...

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Using An Ohmmeter

For Quick T-shooting

--

By Bob Roberts

I really didn't want to go here, especially since this is cutting into the time I have to do the Pac wiring that I've been trying to get to for over 5 years, but I've been hearing more & more people ask continuity Qs & then just buy a fistful of components to throw at their problem :-(I guess just from a lack of understanding the basics... and this applies to newbies & old hands alike... so I'm going to throw together a basic oversimplification of how to use an ohmmeter to prove your component to be either good, or bad.

I decided to use one of the little cheapie pocket analog meters from the Parts Page rather than my "expensive" \$29 Radio Shack analog meter :-). Over the years I've seen so many people go to measure 120VAC line voltage, without checking to see that their meter was set on ohms, & ka-boom! Some lucky ones only needed to change the meter's fuse, but more often than not, the meter was damaged beyond repair, ergo, I thought the loss of an \$8 meter for a newbie would be a bit easier on the game buying capital.

Being from the old school I chose analog because I hate unsoldering parts to check them & digital just doesn't cut it for testing many things in-circuit. Yes... I know digital has taken over the world... TVs, VCRs, radios, clocks, microwaves, automobiles, DVDs... just about everything except Big Ben! Oh, the horror :-(I have a digital remote control for my digital TV which displays the digitalized numerals for the channels & other pertinent info on the screen... which I have to get up & move closer to the screen to read defeating the purpose of my digital remote control :-(Whatever happened to the sun dial? Let me see a hand on a clock face or a needle depicting deflection on my meters :-)

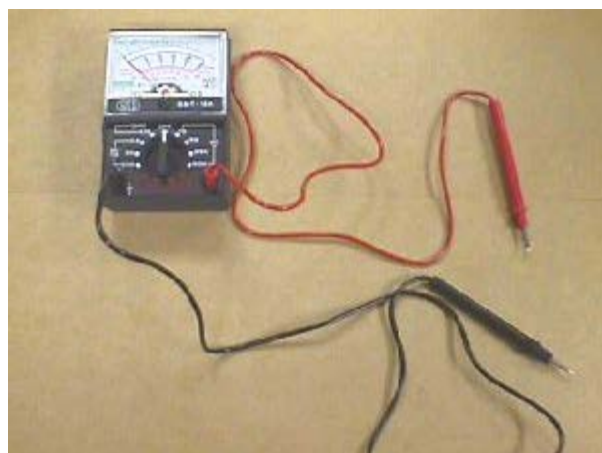
K... let me jump right into this... basically, there are three states to look for:

- **Open** = The meter's pointer will not move showing that the resistance is infinite (immeasurable). If you were to measure a piece of wire from one end to the other you would measure a few marks from zero on the right of the meter. If someone cut that wire in the middle while you were measuring it the pointer would fall to the left (infinite) showing an open... no continuity between the two ends.
- **Deflection** = We're not looking for some accurate reading here, but rather just a deflection showing on the meter which may be at 1/3, 1/2 or 2/3. You just want the pointer to move off infinite, but not go to zero.
- **Short** = This would be the same as touching the two probes together... a dead short that should go to zero, or so close that it will scare you. If you touch a probe to each side of a metal monitor frame you should get a similar reading as any place on the frame should be electrically the same point & a dead short.



The "good" above is subjective depending on what you are trying to find out. For instance, I hear many ask how they can tell if their game's line cord is okay & they are hesitant about checking AC voltages & want another way to test it.

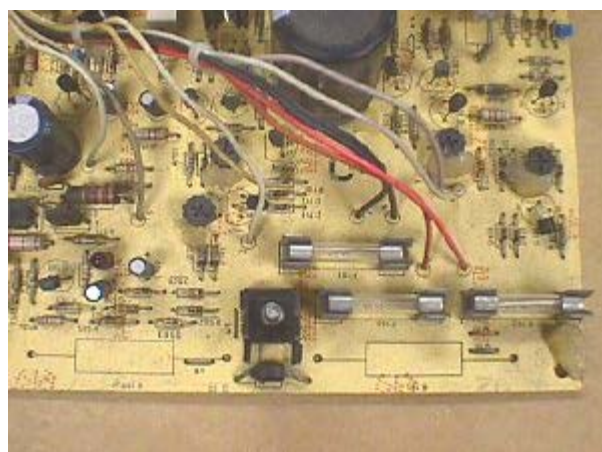
You can unplug the cord from the wall & measure for a short condition from each prong on the plug to the end of the wire inside the cab. This will help you to identify which color wire is connected to which prong, also. Suppose your earth ground wire was a black or white wire inside the cab instead of the usual green.... when you measure from the tubular ground prong the line that shows the short will be the earth ground wire no matter it's color. This comes in handy when someone has changed the plug on the line cord, or worse, spliced the line cord and you are unsure if it was done correctly :- (Just want to see if the 2 main lines have continuity... clip a jumper wire across the prongs & then just look for a short across your line filter terminals inside the cab. Short indicates good continuity.



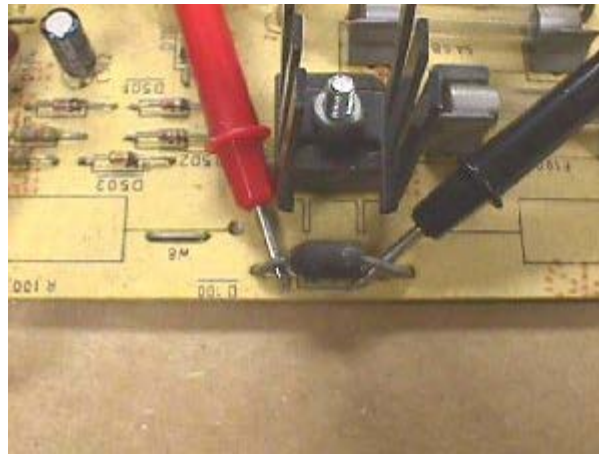
K... here's the little ohmmeter & I'd guess it to be smaller than a pack of cigarettes. It comes with the battery & probes, so it's ready to rock & roll. The positive lead is red & the ground lead is black.



Turn the knob to ohms & we are ready!



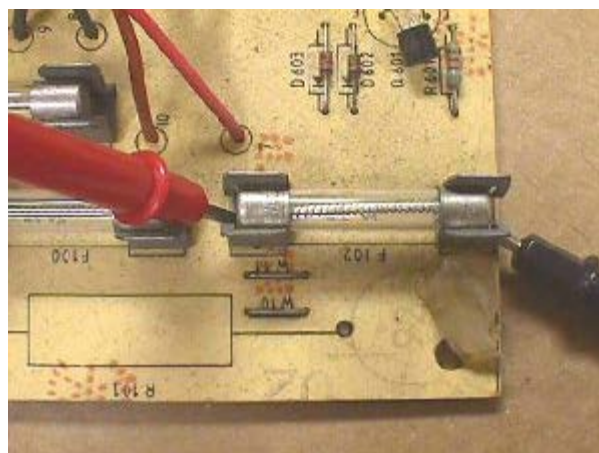
Grabbed this board off the shelf & it has a whole lot of parts that can be tested :-)



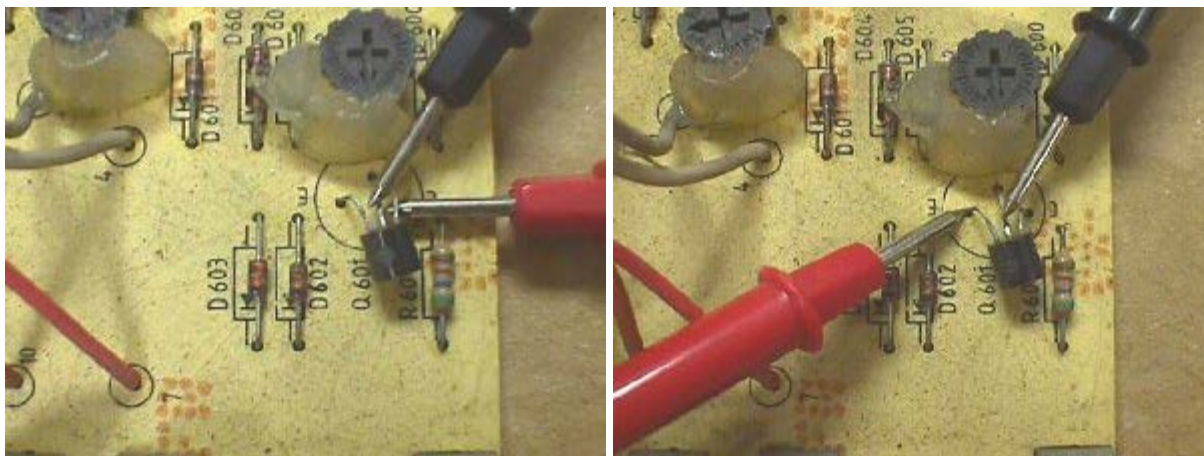
Let's start with this diode. With the red lead on the anode & the black lead on the cathode you should get deflection on the meter as pic'd below. If you reverse the leads it will usually show an open, but in some circuits you may get a minimal feedback reading from other components in the circuit. You need not be concerned with this because if the diode were open you would not get deflection in either direction, and if it were shorted you'd get zero in either direction. This diode is good.



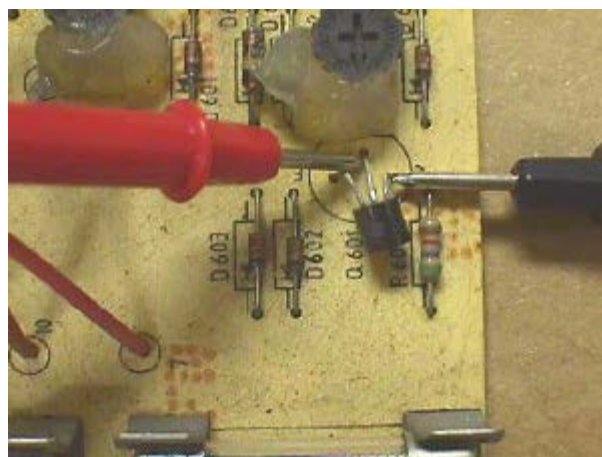
Look at all those fuses. Since we need to see a zero, or short, if these are good, it makes no difference which lead goes where. However, it is best to measure from the base of the fuse holder or even from the solder joints with the board flipped over to insure that you have "good" continuity through the holders, as well.



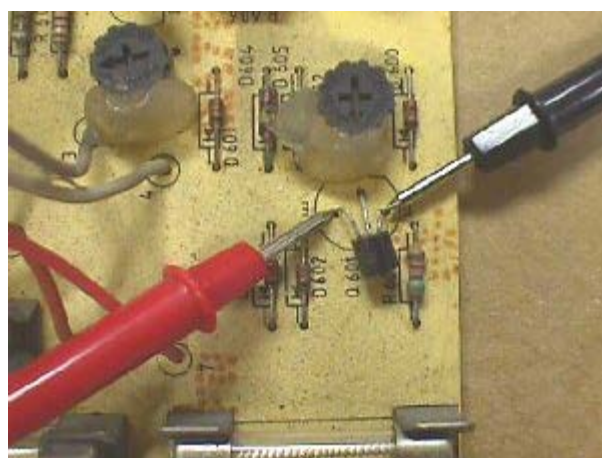
Let's move on to a transistor. This would be like measuring two diodes. You measure from the base (B) to the collector (C) & to the emitter (E). With an NPN transistor you place the black lead on the base & you should have deflection with the red lead on either the collector or emitter.



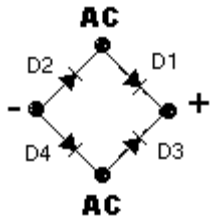
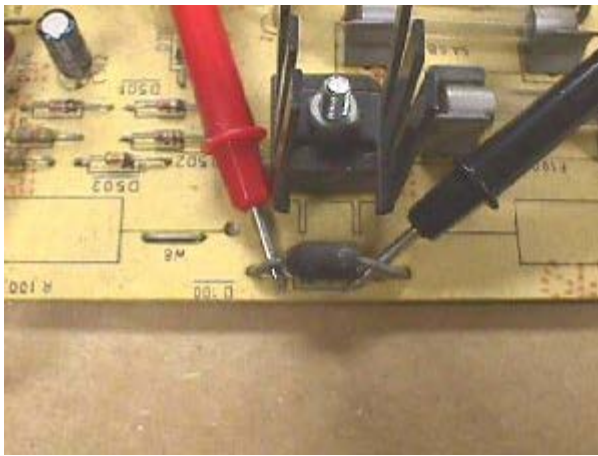
With a PNP transistor the red lead would be placed on the base & deflection would be read to the collector & the emitter. Knowing what you should get for readings will help you to identify which of the 3 legs on any transistor is the base & whether or not the transistor is an NPN or a PNP type, as well as, letting you know if it is good, or not.



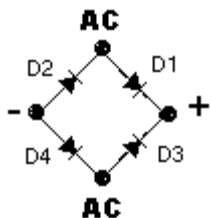
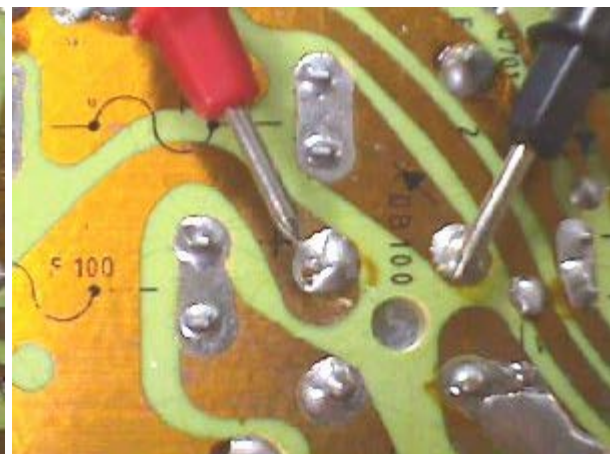
Ocasionally, a transistor will short from collector to emitter, so you should measure between the two as pic'd below. Note that some transistors have an internal dampening diode from collector to emitter, so it is possible to have deflection as long as it does not go to zero.



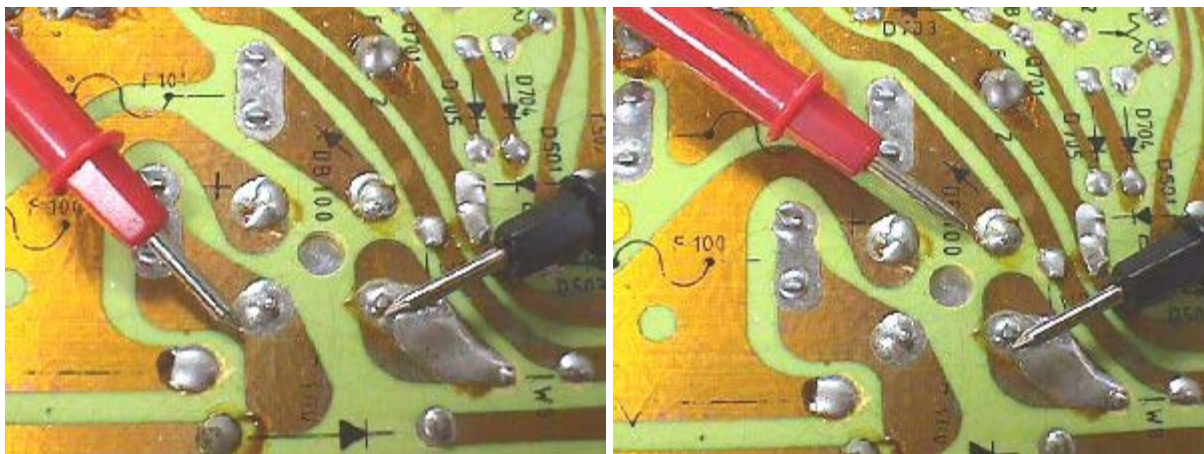
Let's check the bridge rectifier just above the first diode that was tested. The bridge is close to the PCB leaving no room for the probes to touch down, so it has to flipped over & measured from the solder side.



I think it will help if you see what the inside looks like. This bridge is nothing more than 4 diodes inside arranged in the configuration to the left. The junction where the 2 anodes meet is marked as - and will be ground in your circuit. The junction of the cathodes marked as + will be your DC voltage out. Testing this will be the same as testing 4 diodes even though you cannot see them. Putting the red probe on the terminal marked + you should get meter deflection when the black probe is touched to either AC terminal. One will insure that D1 is okay, while the other will insure that D3 is okay... inside the case.



You test D2 & D4 much the same way, but you need to put the black probe on the terminal marked - and then touchdown on each of the AC terminals with the red probe to view deflection. No matter what the diodes are encased in, they should read the same way. Red probe to the cathode & black probe to the anode will give you deflection & reversing the probes will show an open. Although most failures are shorts, some are opens, so when you don't get a deflection reading that you know is suppose to be there you should reseat the probes & try again & if you still do not get deflection it's time to change the bridge, or single diode, that you are testing.



Bridge rectification does not need to be in a single case. Many circuits simply use 4 singles on the PCB as pic'd below on a K7000 chassis. The bridge is comprised of D19, D20, D21, & D22. You can see the junction of the 2 anodes (-) going under the large filter cap & connecting to ground. D19 cathode loops down to D22 cathode to form the + junction.



I have enough of this done to be of help to some, so I'll post it as-is on the Help Page & add to it when I can.

Happy Gaming...

[Site Index](#) - [Big Bear's Bulletin Board](#) - [Parts Page](#)

What's My Capacitor?

How To Heck Do I Know The Value?

By Bob Roberts

Here is another area that newbies & old hands alike run into trouble with :-(I'm always asked how to figure out what a cap in hand has for a value. It has just 2 numbers on it... it has 3 numbers & a letter... what to heck is it? Caps are coded more or less the same as resistors are but using numerals instead of colors. Use the first 2 numbers as-is & the third is the multiplier. Of course, back in the day they were color coded using the same code as resistors, either with domino dots of color, dashes of color or actual complete bands much like the resistors are today. If you're restoring an old jukebox or anything from days gone by, you may run into some of these older caps, so knowing the color code should be helpful.

As always, I hate getting into the technical aspects because I know this is your hobby & all you want to do is be able to read the common caps for replacement & could give a hoot about all the techie stuff, so I'll just give you the basics & then list some of the commonly used caps stated in various ways.

Capacitors are measured in farads, but 1 farad is much larger than anything used in coin-op games or any other small electronics for that matter, so we start out with fractions of a farad. I'll put the divisions below, all of which can be crossed into another division, & the abbreviations can be either lower case or upper case. They started out as a mix of both, but have become common place either way over time.

- *picofarad* 1 trillionth = pf = pF = uuf = mmf = mmfd = 1/1,000 000 000 000
- *nanofarad* 1 billionth = nf = nF = 1/1,000 000 000
- *microfarad* 1 millionth = uf = uF = mf = 1/1,000 000
- *millifarad* 1 thousandth = 1/1000 = Too Big For Us

K... how do we figure out the value? Let's start with caps with 2 numbers on them. These are assumed to be picofarads & if you have a letter it is the tolerance, typically a K for 10% +/-, I don't know of any app that we use that we would have to be concerned with this letter. Many are fooled by the K thinking it is like K for kilo with resistors... don't make that mistake or you'll be way off the mark with your value.

Examples

22 = 22pf = .022nf = .000022uf
 33 = 33pf = .033nf = .000033uf
 56 = 56pf = .056nf = .000056uf
 68 = 68pf = .068nf = .000068uf

Three numbers... first two as is & the third is the multiplier with the results in picofarads. It seems to be easier for newbies to think of the multipliers as just the number of zeros to add to the first two numbers.

Examples

104 = 10 0000pf = 100nf = .1uf

$103 = 10\ 000\text{pf} = 10\text{nf} = .01\text{uf}$
 $105 = 10\ 00000\text{pf} = 1000\text{nf} = 1.0\text{uf}$
 $503 = 50\ 000\text{pf} = 50\text{nf} = .05\text{uf}$
 $682 = 68\ 00\text{pf} = 68\text{nf} = .0068\text{uf}$
 $822 = 82\ 00\text{pf} = 8.2\text{nf} = .0082\text{uf}$

Going from picofarads to microfarads is just simply moving the decimal point 6 positions.

Examples

$50000\text{pf} = .050000\text{uf} = .05\text{uf}$
 $330\text{pf} = .000330\text{uf} = .00033\text{uf}$
 $22\text{pf} = .000022\text{uf}$

Think you have a handle on it? Here's a curve ball.... some mfrs put the value on the cap in ufs, so .47K now reads in ufs & not pfs. When the decimal point is on the cap it reads in microfarads.

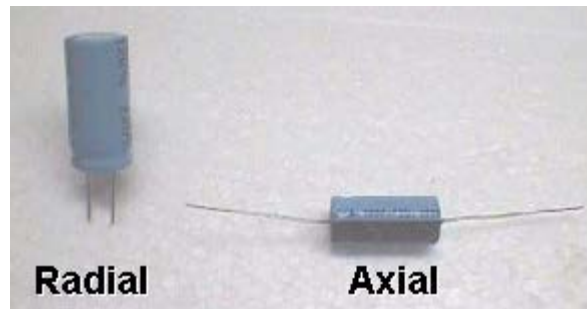
Hopefully, this has armed you enough to determine what value cap you have.

April 2007 Addendum

Here's a simple Q that is asked so many times per week that I am compelled to place the answer here:

How do I tell if I need *radial* or *axial* caps?

Radial caps are ones where both leads come from one end & axial caps are ones that have a lead on each end.



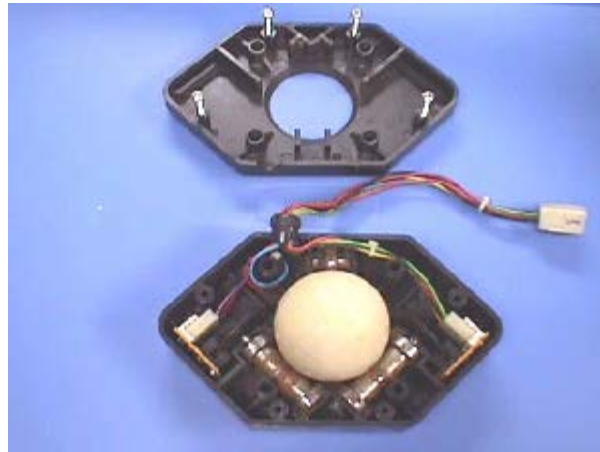
Happy Gaming...



Reviving An Old Wico Trackball

By Bob Roberts

I'm going to snap a few pics here as I revive an old rusted & seized up Wico 2 1/4" replacement trackball unit. I'll try to include answers to any FAQ's pertaining to trackball units as I go along. The first of these is whether they will fit on a Happ mounting plate and the answer is that they will. All the trackball units have the same bolt hole pattern in their size, i.e., a 2 1/4" trackball from Wico, Imperial, Dukinc, Happ or other OEM, will all fit on a 2 1/4" TB mounting plate. Can you imagine if they didn't :- (If Wico had a 100,000 units made up in their own style of mounting & you went to install one on, e.g., a Centipede control panel & found they would not match the bolt hole pattern... hmmm... Wico's phone lines would be tied up indefinitely... as would any of the others!



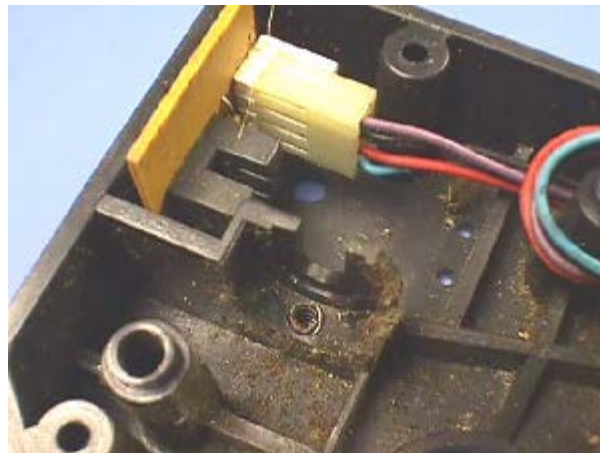
The first thing to do is remove the 4 screws that hold the two halves together. I put them back in the top half, so that you can see the layout for them in the pic above. Take note of your wiring for later reference & remove the rollers & bearings (most likely rusted together as the pair below were).



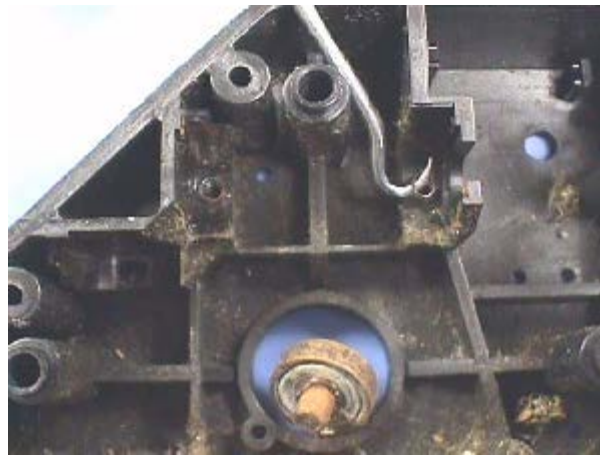
Although these are pretty well rusted the wear line in the center of each roller is not too bad & had there been less rust they probably could be reused. The reason that these particular ones could not be reused was that the rust had eaten into the shaft making it pitted & scalloped, hence making for a herky-jerky ball movement rather than the smooth gliding ball that you need. I'll tell you what to do with these rollers & bearings in a bit, but it's best to continue disassembling for right now & the reason will be forth coming.



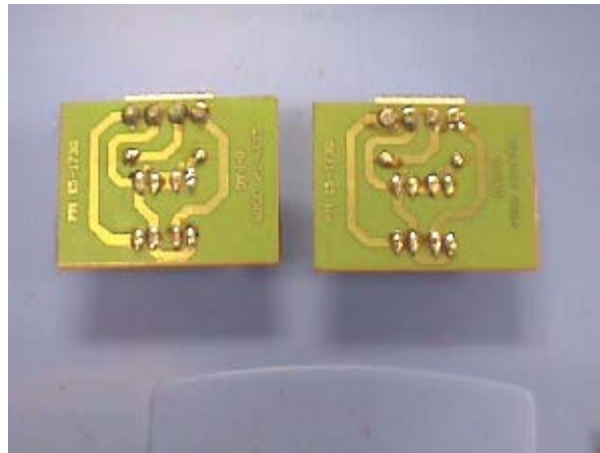
In the pics above & below you should take note of the wiring to the optic bds. Like any other trackball unit, the red & black wires are +5 volts & ground and should never be reversed. Also take care when replacing these plugs on the headers to be sure you do not miss a pin & hang out over one end or the other of the header. Doing so will destroy the optic bd. Your 2 outside wires in each connector are the clock & direction. As with other trackball units, you can reverse these to achieve proper control on screen. If you find that when you roll the ball upwards it responds with a downward motion on screen, or when you roll the ball left to right the response on screen is right to left, swapping the clock & direction wires will correct this. The positioning of the whole unit will also effect clock & direction, so make sure that you don't just have the unit upside down before moving wires. You could get into a perpetual changing of the wire positions if not careful :-)



K... now you can pull the harness, optic bds the four seating springs. If you use a spring hook to remove the springs take care that they haven't been welded in with some Cola at some point in the past :-(Once the springs are out you can take the housing & the ball and soak them in some Fantastik while you're looking into whether or not you can save your bearings & rollers.



Be sure to look over the pins in your harness connectors & check the header posts on the optic bds to see that they are soldered in good.



If you're going to try & save the rollers or the bearings, or both, you'll have to separate them. The best way I've found is to place the bearing on the open jaws of a vise & gently tap the end of the shaft being careful not to mushroom it. If they are welded real tight you may want to soak them in some penetrating oil first. To protect the threaded ends you'll need to thread in a 1/4" x 440 screw & tap lightly on it to free up the bearing from the shaft.



The shaft is not secured in the vise, but rather suspended by the bearing, and using a blunt end punch will help insure that you do not mushroom the ends, making it necessary to file them before you can insert new bearings.



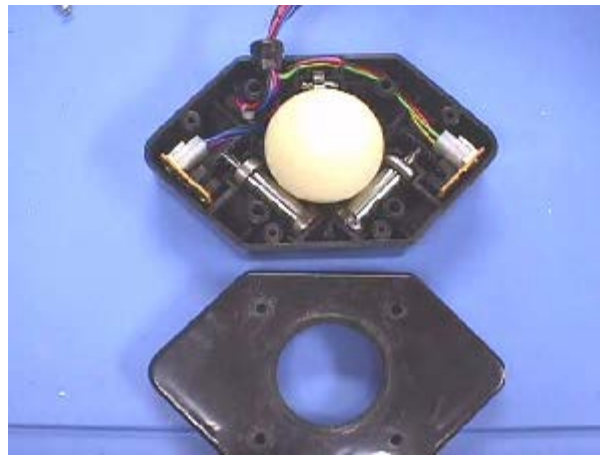
Be careful not to slip with the punch & damage the bearing. I used the one above & you can see it is slightly smaller than the shaft diameter, so that it doesn't damage the race of the bearing.



You can attempt to salvage your bearings the same way as described on my Help Page [here](#). Using a Scote Brite pad on the shafts will clean them up, although it will not even out any pitted areas. Here's a tip for when it comes to remounting the encoder wheels above.... they should be in the center of the optic & not close to one side or the other. If not centered they may rub against the optic while in use. You can try flipping the encoder wheel over & if you are still off center you can insert a small washer behind it to act as a spacer.



Time to finish up the cleaning of the ball & housing that has been soaking. After scrubbing them up they should be rinsed thoroughly in cold water & a hair blow dryer will help speed up the drying. Once completely dried it's just a matter of reversing the disassembly process starting with the springs & stuffing everything back in there whether it be the salvaged parts or new parts.



Lube the bearings & close the hood... you should be good for another 100,000 miles :-)

The new [roller set](#) for the Wico 2 1/4" TB unit is available on the Parts Page [here](#). Bearings can also be found on the Parts Page.

Happy Gaming....

Wico 3" Rollers

August 26, 2008

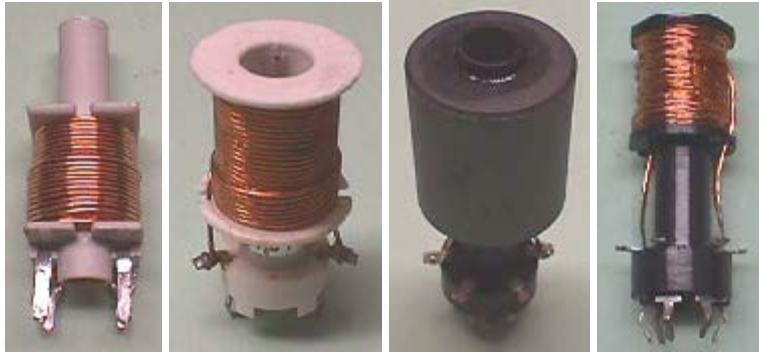
In regards to what I have been saying for many years pertaining to cutting the long 3" Atari roller shafts down to fit the Wico or Imperial trackballs... it has finally been confirmed possible by Adam Pletcher. Here's what he had to say, "So it turns out, if you cut off 1/8" or so from the two Atari rollers with a dremel they fit the import TB units perfectly. The wheel screws even still fit. I just marked it next to the old one and cut." That should help many of you & my guess is that you could probably accomplish it with a hacksaw if you don't own a Dremel, as well.

The bearings are the same, so this 1/8" on two of the rollers is the only difference between the Atari set & the Wico/Imperial import sets.

Happy Gaming.....

Adjusting Width Coils

By Bob Roberts



This seems to be an area that many newbie & old hands alike run into troubles with :-
 (The very first thing you should know about adjusting width coils is to NEVER adjust them with a metal Allen wrench! It seems that everyone, even people that don't own a hammer, have an Allen wrench at their disposal. Take a look at the pic below of an Allen wrench because even a person that told me he didn't know what it was, after looking at the pic said, "Oh yeah, I 've got those!"



There is more than one reason not to use this beast. The first is that the ferrite core that you are trying to adjust will not stand up to this.... it will crack rendering it useless since you can no longer move it through the field. Ferrite is a composite chemical compound of iron oxides & other metallic oxides that can be rapidly magnetized & demagnetized.... made from powder, so to speak... so it is not strong enough to stand up to the torque of an Allen wrench. Add to this mix the fact that the cinching material.... rubber band-like piece that secures the core to the coil form's inner wall.... has melded the core to the coil form making it virtually impossible to move, and you have a core that has no choice but to crack, break & even crumble!

The second thing would be the ease in which you can get a shock trying to manipulate this metal conductor around the chassis' many hot spots. If you are uncomfortable in working with even plastic alignment tools around a live chassis, I would suggest adjusting the core a little at a time while it is off & then firing it up to see your results. I've seen first hand that getting a shock is not always what does the most damage, it's what you do after being shocked! Some will instinctively throw their arms about breaking other things, cutting themselves, while others will jump & run around in circles yelling & screaming.... well... you just never know how you will react to getting a shock and there's no sense in tempting fate to find out :-()

So you're a tough guy & a little shock is not going to bother **you**.... well, you will still encounter yet a third disparagement that will certainly keep you from doing this, at least while the chassis is live, and that is that the Allen wrench will heat up enough to burn your fingers... badly :-()

The correct way to adjust the width coil is with a plastic alignment tool. If you adjust while live & viewing your results directly, always be aware of the surroundings & don't lose your concentration to where you allow your hand or arm to brush any of the exposed hot spots for one of those shocking experiences :-)



At the onset of adjusting any coil, new or used, you would test the ferrite core to see if it is frozen with the end of the tool that has a shaft of a smaller diameter than the actual hex end as indicated in the pic above with the "X". This end is more flexible & will give, twisting a bit, as you try to turn it. Try both ways in a rocking motion. If your ferrite doesn't want to move at this point then there is no magic potion to free it, that I am aware of, so it's going to take careful coaxing from this point on.

If it's a used coil you are trying to adjust you would now swap over to the end that has a larger diameter than the hex end... beefier for more torque, but you still cannot force it as it will break the same as if you were using an Allen wrench.... it just takes a little more pressure. You want to apply a moderate pressure in one direction followed by an equal pressure in the opposing direction while the coil form is cold... having set for at least 15 minutes with no power applied. Not getting it yet? Try running the chassis for an hour heating up the coil & then repeat the previous process. It takes patience & maybe several cycles of this torture, but they usually free up to useability, lasting for years to come.

If it's a new coil stuck from newness, rather than melding, the key to freeing it up successfully is somewhat the same as with the used ones, but the ferrite core on a new one is fed in through the bottom during mfr'g & generally stops even with the top portion of the actual coil. In most cases, this works out to a no-need-to-adjust position, but when it is necessary to adjust while new & not wait till the expanding & contracting of use make it sloppy in the coil form, you need to inch it downward toward the direction of it's original insertion. Much like a screw that you have only screwed into a piece of wood halfway, it is much easier to back out than it is to thread it in further. You are actually backtracking down the threaded portion of the coil form, & generally, you never need to raise the core up into the hollow top portion of the coil form, if your coil has one... some don't. If you have a well broken in coil that travels the entire length of the form, you can see that as the ferrite core moves through the form you will have 2 distinct full ranges of adjustment distance.... as it enters the coil's field from the bottom & as it exits from the top... so there is nothing to be gained by moving up into the top of the coil form & this is usually where they are broken by plastic tools. I imagine the thought behind this is that you will somehow gain width by adjusting into the top of the form, but that is not the case. Turn your core in a clockwise manner & if you encounter any resistance, then you can back it off a bit & try again... rocking it back and forth to gain ground.

Don't beat up your coil for no good reason. If it doesn't have the travel you think you need, make sure first as it could be that it is already at it's max position & you have circuit troubles rather than an adjustment problem. A common incidence of this would be in a G07 chassis that you have recapped & installed a new width coil, but

failed to adjust the B+ voltage up to 120 VDC causing a lack of width in the pic that no coil will ever regain for you.

Note: [This reminds me of the cause of so many premature deaths of coils on the G07 chassis, as well as others, during the process of recapping the chassis'. Take care to prop the chassis in a manner that prevents the coil from becoming a "kickstand" for the chassis while you work on it :-(Even a brittle coil will last for years if not brought to task in this manner!]

If your pic is shrunken from the sides it is easy to see your results as you move the ferrite through the coil form & when you see that you are at a point where the pic starts to ebb in either direction, you are at max width & need to look at other circuitry as the cause of shrink. If your pic is wider than the screen, then pick a spot that contours an object on the screen, or cross hatch, if you have the luxury of a generator or PCB test pattern, and place a piece of electrical tape on it for a reference point to judge your travel on. Once you see that you have reached a point where either direction of turning nets you the same results... you've reached the minimum range of width & it's time to look at other circuitry as the culprit for your dilemma... perhaps the B+ being too high.

Tip: When replacing old worn out coils you should save the ferrite cores as they will come in handy if you ever break one in a good healthy coil form. If this occasion arises, use a hand drill with a small bit to drill the center of the broken ferrite core that needs to be removed. It'll come out in pieces & after cleaning the residue you'll be ready to give it new life with your previously saved core.

Hopefully, this is enough info to keep you from burning yourself, getting shocked or maybe saving the lives of many coils.....

Happy Gaming.....

PostScript:

Here's another FAQ in one form or another:

How do I keep from getting a shock on the chassis' that have the width coil in a tight place next to the flyback transformer?

Here are 2 ways to handle that.

- For the brave of heart.....

Take an ordinary plastic drinking straw & insert your width coil adjusting tool into one end & tape it in place.



You can stiffen up the turning end by taping in an unused adjusting tool.... or any piece of plastic or wood that will fit. Actually, although I've never tried it, you could probably fill it with hot glue or an epoxy to make it a permanent tool.

- For the not so brave of heart.....

Mark the face of your screen at the outer edges of the pic with a piece of

masking tape to show your current width & then power down. Pick a direction... clockwise or counter... and then adjust the coil 1/4 turn, power up & note the difference. If your pic is narrower, power down & change direction going back a 1/2 turn to compensate for your wrong move. Power up & see if you've gained enough width, and if not, do the same procedure a 1/4 turn at a time in the same direction until you've achieved your goal without the possibility of shocking results.

Thermal Wire Stripper



I've been asked several times over the past 8 years how we handled so much wire stripping... was it all done by hand or did we have one of those multi-thousand dollar measure/strip & cut machines. Well... the Patco handheld thermal wire strippers were used for all wiring over the years. I bought both the 120VAC units & the cordless battery type. They both worked equally well for everyone, but not having a cord to catch the cordless unit, whenever it got knocked off the workbench, proved to be it's downfall. After a few times the case would finally break & given that, and the fact the battery would eventually die, I opted to stick with the plug in type.

They get hot in a matter of seconds, so there is no waiting for them to heat up, and they don't get hot enough to seriously burn your skin if you touch the blade. Just a quick twist of the wrist & your wire is stripped to where ever you had preset the guide, so when doing a lot of wiring, and especially when making harnesses, this thermal stripper became an essential tool at an affordable price.

If you do a lot of wiring these will surely make the job easier for you.

Williams Games Lithium Battery Conversion

by Bob Roberts

Way back in 1980 I started bugging the techs at WMs about this faux pas of a battery system that they started out using. I had lots of ops complaining about the loss of memory, curiously enough, because they did not want to comply with store owners in giving them a key to advance the game into operation again. Of course, they did not want to be going to location every day to do it for them, either. I'm fairly certain that it was a Tri Zone pinball that one of the local music companies dumped off at my shop & said they had enough & to do whatever it took to get it stable for location. That flakey 3 x AA battery setup was just an albatross & really a black eye for WMs good reputation. I'm embarrassed to say that I don't remember the tech's name out there, but I believe it was Tom or another easy 3 letter name like Jim, anyway each time I called & chatted about it we seemed to get off topic & onto Bingo machines... what I had broken into the business on, and what he seemed to have a fancy for. At first, the advice was to tighten up the holder then on to install a new holder with fresh batteries and it evolved to double strapping the batteries in & even a mention of drilling holes in the PCB to run another cable tie through, none of which was appealing to me, even though I did try them without a satisfactory outcome, so I setout to change it completely to a backup system that would work.

The new kid on the block... well, through the 70s... was the lithium battery. I'm by no means a battery expert, but I setout to obtain all the info that I could on them. Seemed like everyone was warning how unstable they were and one person I spoke with told me that tossing one into an open fire could blow up a building :-() Enough good reports made me file this away in the back of my mind, because by this time others had been telling me how far the technology had advanced & that they were perfectly suited for my needs at this point in time. They were reported to have a shelf life of 10 years... to which I can say now, was an understatement as I changed my battery in my test bd in June of 2000 for the first time since February of 1986... and were very easy to install with several types to choose from.

The pinball machine had been at the shop for several weeks by now, so I called the owner of the music company & explained to him what I was going to do & that the research had slowed me down a bit. I told him I'd like to keep the machine for a few more weeks to see how this lithium setup was going to work out. Hmmm... he said that the last distributor that had been servicing for him would have kept the machine for 6 months anyway, so keep it as long as I wanted to.

After installing the lithium... still very cautious as that one reply was rattling around in the back of my mind, but one should always approach the unknown with caution, anyway... I tested it in every manner that I could think of including the mule kicks to the bottom of the cab when it was sleeping :-) This was it! I could not steal it's memory from ram... it was solid & stable as most had told me.

Caveat: You should take care to follow recommendations by the battery mfr in regards to safely using, handling & disposal of lithium batteries. Never try to charge one of these lithiums, or use it in a circuit that has a built-in charger, as with anything, improper use can be dangerous.

This was such an easy conversion, one that I knew had to be done & could be no worse than the existing system, so I bulled right into installing them wherever I could find an opportunity. I remembered a local root beer joint that had a similar complaint on a Defender & called to ask if it was still giving trouble & the reply was an emphatic yes, so I offered to go out & install this conversion for them at no charge. The owner was thrilled and even though the 3 basic machines

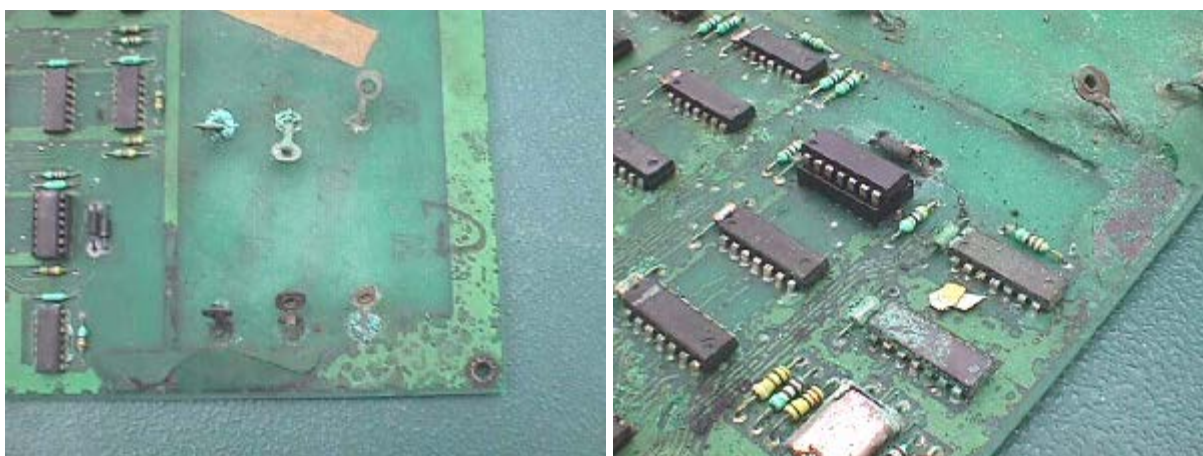
in the place were owned by him, he still was aggravated that he had to open the coin door so often to advance the machine into operation. This particular case was my first callback, albeit a few years later, and the complaint was it's doing the same thing as before. Even though this was a common complaint... repair the monitor & 8 months later get a call stating that the game was doing the same thing it was when I repaired it last month - **no sound!!!** ... I still wondered if this was going to be a flaw in their longevity. Fortunately, when I got there I found it was in ram error & a quick replacement of a 4116 brought it roaring back to life... no, this service call is not lagniappe, I had to tell him :-)

Trying to get back on track.... everything that I had installed this into was working just fine, so I called the WMs tech line again & told them how well this was working & asked if they knew of any repercussions that I might have, and Tom, Don, Jim, (sorry) whomever it was, said they thought it was a good solution, but that only time would tell. He said he was going to take it up with their engineers, or something to that effect, and he would let me know if they found fault with this setup. That was the last of our conversations.

In later WMs boards the lithium battery came installed, albeit a solder in type that I had opted not to use making it easier for ops to change the battery, if need be, without losing mem. I'd like to think I had something to do with that decision, but the truth of the matter is, that would be just a logical progression of technology in any event. It was just bound to happen, sooner or later.

Okay... okay. Enough with the ancient history talk... how do I do this conversion! Let me snap some pics & tell you... oh no, more pics! I think they are more informative than the thousand preceding words :-)

Let's look at what happened to the old battery system & the boards over time.



These are from some old trade in boards that have been sitting around the warehouse without any batteries in them for years, but once the alkaline starts the erosion process it just keeps spreading regardless as to whether you have batteries mounted, or not. It snakes it's way along the traces & surfaces to attack components sometimes on the opposite end of the PCB :-)



You can see above that it also attacks the header pins... I bent these over so that you could view the damage since they are no longer any good at all & need to be replaced :-(If the contacts are like the one in the pic next to it, they are going to be intermittent, no matter what you do to attempt correction.

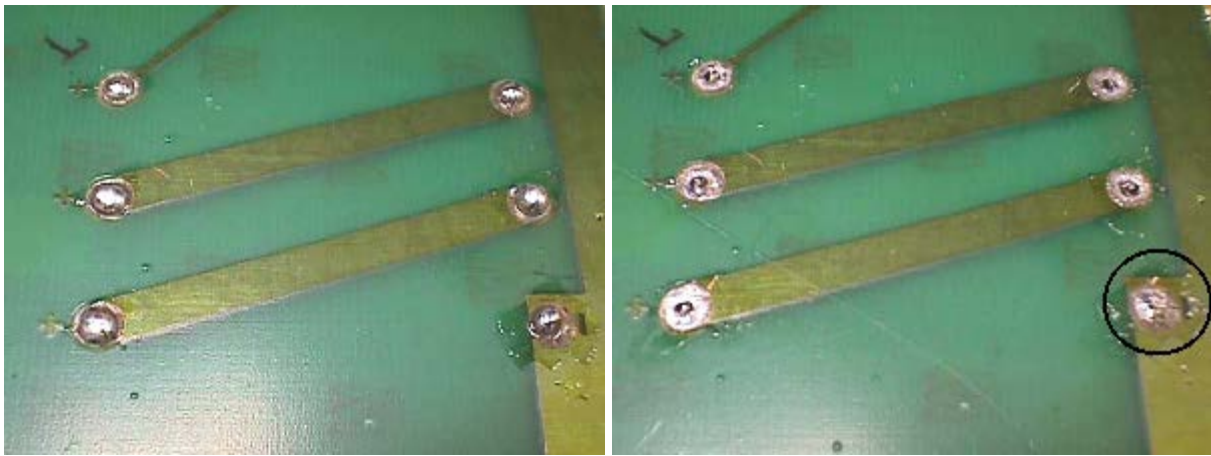


Above you can see that the actual contacts inside the holder are completely gone with only the rivet showing in the center. You can also see that if any one of these terminals is the least bit corroded it will open the supply to the ram causing it to drop to zero & thereby robbing it of any data that was stored in it. This does not necessarily mean that the power needs to be off, either, as many have said before, especially in the case of a pinball machine that gets banged around a lot... not that vids don't, because I've seen them after a wild Saturday night & it's a wonder that they work at all... and this is just not immediately known as it has no effect until the game is turned off. Of course, if the batteries fall back into place & are making good connection before you turn the game off everything will be saved, but are you normally that lucky? :-)

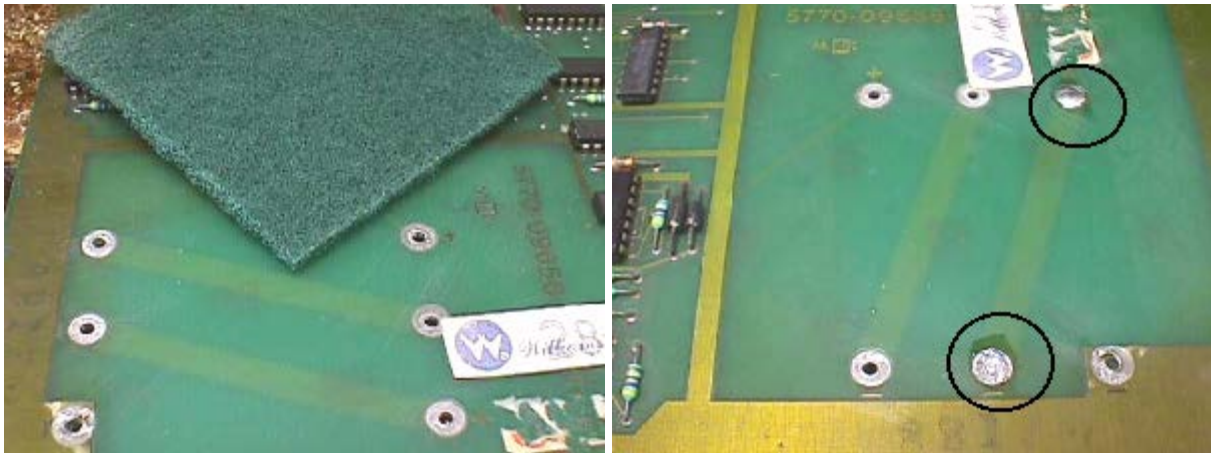
Here's all you'll need to make this conversion:

- 1 CR2032 Lithium Battery
- 1 CR2032 Battery Holder
- 1 2" Piece 18ga Wire (Black Is Best)
- Solder, Iron & Scotch-Brite

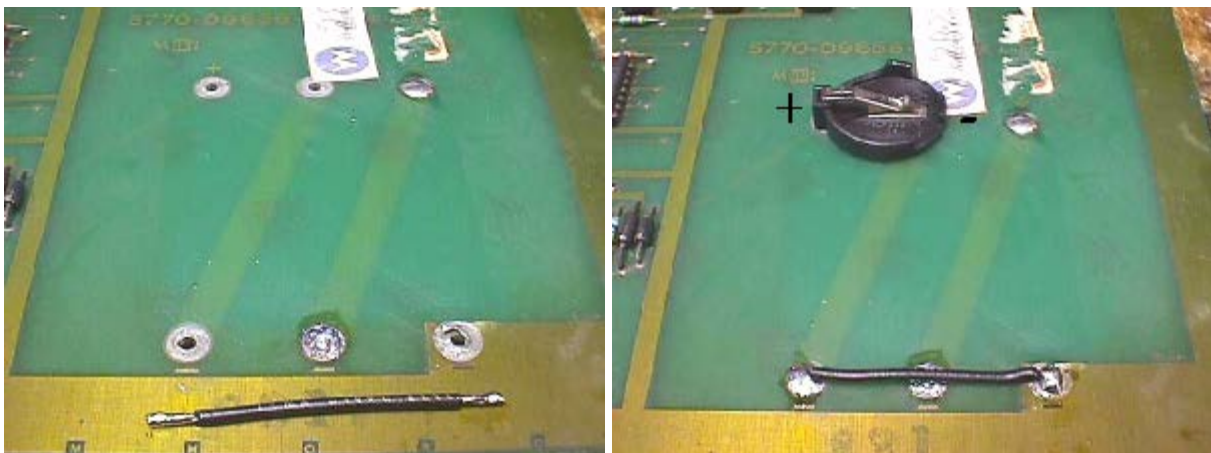
You can burn up \$5 worth of gas running around town looking for these components, or I have them available as a [kit](#) for \$5 when you're ordering your other supplies.



K... Let's get started by flipping the board over onto the solder side & heating up each terminal of the triple AA holder & flowing in some new solder to reactivate that old won't-even-melt-solder. Start over again with the first one you did & this time remove all the solder with a solder sucker. The tough one is usually the one that actually connects to the ground rail. If you have all the others free you can take a small screwdriver & insert it under the holder at the stubborn joint, heat & gently pry at the same time. It'll usually pop right out that way.

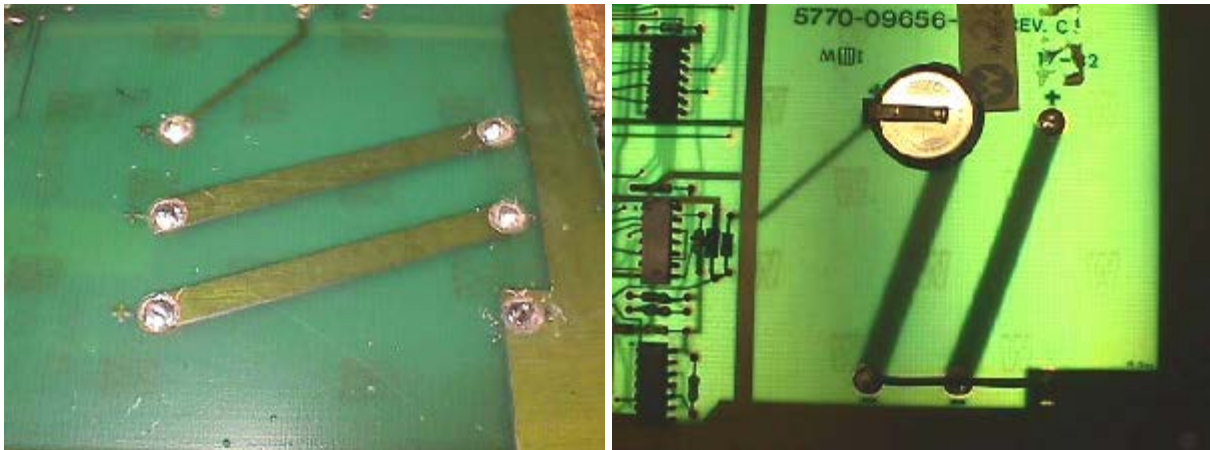


Next you'll want to Scotch-Brite those thru-hole pads so that your solder will adhere & to clear away any corrosion left on them. Do both sides. Now close in the bottom middle & upper right holes with solder as show in the pic above right with black circles.



Take the 2" piece of wire, strip back approximately $\frac{1}{4}$ " on either end & tin with solder. Bend the leads to 90 degree angles & drop it through the two lower outside holes as pic'd above... solder it

in. Now drop the battery holder in from the top with the + terminal in the upper left hole & the - terminal in the upper middle hole. This is a perfect drop in alignment, so when you flip it over to solder it in you can lay the holder on your bench & the weight of the board will keep it in place while you solder it.



Slip the battery in with the + side up & clean up any mess you've made with solder on both sides of the board & you're good to go. The pic above right is taken on the light board & you can see the right end trace that we eliminated very clearly. It is just sitting there taking up real estate now. The jumper on the bottom gives us a new path to ground & the holder's positive terminal connects right into the ram backup power circuitry. You can measure your voltage to see that everything is copacetic if you like. Measure from any logic ground to the blocking diode on the left... first component you see the trace going to above. You can follow along the path it takes, which is a long one, over to the cmos ram located in area of D1 or D2 grid on the board... near the CPU.

If you still experience occasional memory loss after installing a lithium battery, you'll find most times that it is due to the poor header connections on the linear power supply. In cases where you already have swapped over to a switching power supply... thus eliminating these headers... you'll find that the problem is a weak component associated with this memory circuit from the few diodes, to resistors, to capacitors, transistors or even other kept alive ICs in the circuit, depending on which board you are working on. Don't have a clue how to track down & repair this problem then maybe your shortcut is to install a Dallas nonvolatile SRAM DS1225.

K... time for a quick review list for those who work better from them.

1. Reflow old solder using new solder.
2. Remove the existing battery holder.
3. Fill in the lower middle hole with solder.
4. Fill in the upper right hole with solder.
5. Jumper the 2 lower outside holes with a 2" wire.
6. Place the battery holder + terminal in the upper left hole
(Closest to the center of the PCB & - will drop into place.)
7. Add your CR2032 lithium battery.
8. You're good to go, test if you like.

This will work in many other cases, but beware that you cannot just drop this in place of a ni-cad without defeating the charging system. This can be done by installing a blocking diode in the + line. I'm quite frequently asked how one can tell which way to install the diode. I think it is easiest for a newbie to think of the cathode stripe on the diode as a gate in the front yard fence that only opens outward as you are leaving your home, with the body being your walkway, of course. No one can walk up to your gate & pass through to enter your home, but you can walk

down your walkway (diode body) and out through the gate. A diode with the complete symbol imprinted on it will have an arrow with it's point butted up to the cathode band signifying the direction of flow. If used as a blocking diode for a lithium battery you would want the cathode on the end furthest away from the + terminal, thus allowing the flow down the walkway to the components, but blocking at the gate any flow back towards the battery.

I feel compelled to place the battery warnings here, as well. This is a compilation of warnings from Rayovac®, Duracell®, Energizer® & Panasonic®.

1. Do not install backwards.
2. Do not charge!
3. Do not throw into fire.
4. Battery may explode or cause injury if above is not adhered to.
5. Do not attempt to disassemble battery in any way.

Update August 2006

Over the past year I have been receiving quite a few emails pertaining to this battery conversion. I don't know what sparked this after so many years... perhaps just a new batch of hobbyists or collectors... but I thought I'd just answer some of their questions right here.

It all started some time last year with a few emailing me to tell me that someone stole my idea & was selling the battery conversion kits. Although I am pretty sure that I was the first to ever do this, someone else may have tried it years ago that I am not aware of. This generation has all the advantages of the technology explosion. In my time, we stored info on tape & thought we were on top of the world when we got to use our 300 baud modems to transfer files over the phone... you know, with good luck & a static free line it only took you a half hour to transfer a small file across town, but we were happy. Today it takes nanoseconds to transfer a file like that anywhere in the world! We're all in one big room now & everything is at our fingertips, unlike the way it was back when we needed to wait for the Pony Express to arrive in town to learn of something new, so it's quite possible someone else had the same idea at the same time.

In any event, anyone can put together this kit & sell it. I only keep this stuff stocked for your convenience, making it available to ship with your other parts. As I said above, you can certainly find this stuff cheaper right in your home town, but the gas alone will cost you nearly as much. When you need a loaf of bread you don't go to the Super Store 12 miles away... most times... you just go the corner store & pay a little more for the convenience.

BTW: I'm filtering through my email to cover these Q's & statements. Here's another... you're getting rich off everyone with these kits. I bought the same thing at rat shack for \$2.70.

Well... if you didn't spend \$2.30 in your time & gas you're doing good & came out ahead of the game. As far as me getting rich offering this service in it's entirety, nothing could be further from the truth! Only 2 years have we actually gone into the black & after each one we adjusted accordingly. It seems to escape some people that we have to pay the sales tax, or use tax, so that you do not have to. We also pay the shipping on the items you've requested that we keep in stock. Our home has been turned into a mini storage unit & sure, some parts are 4 times the cost, but they are small parts that require large purchases, storage space & a good hunt in locating them when you finally order them. These things help make up for the items that are underpriced to make them affordable to all. They also offset items that so many request & then are never sold.

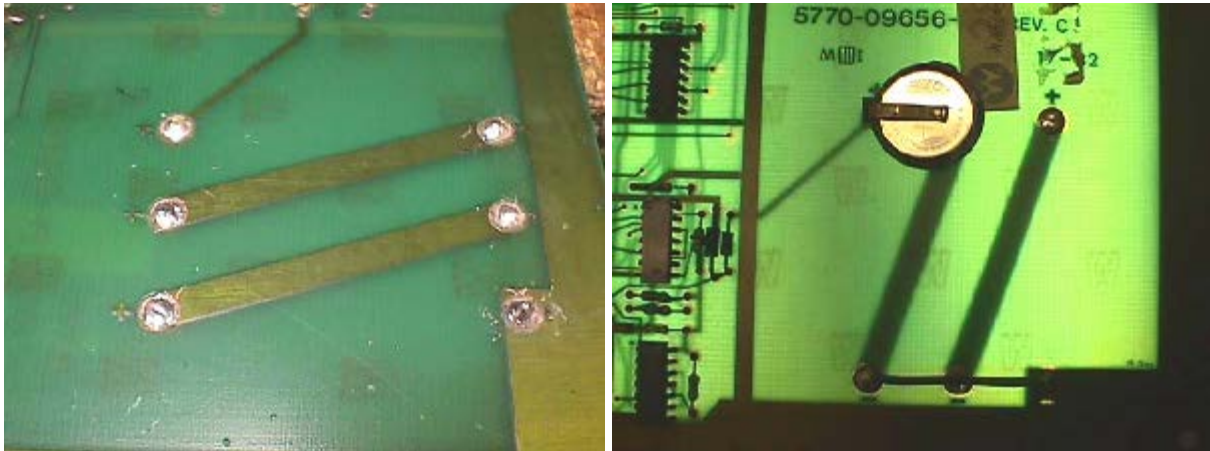
While I'm here, it wouldn't be me if I didn't ramble off a bit, so another thing that I just read was

how some other online arcade supply stores are selling my products, or similar ones, at double the price & are really ripping people off. Guys.... anyone who is doing this for a living has to charge more to cover employee wages... jeez just the matching of SS tax can be a killer by itself!...rent, lease or mortgage payments, electricity and all the other things that fall under the umbrella of overhead! C'mon... ripping people off? I don't think so & I often wonder if the owner has anything leftover at the end of a week to support his/her family with!

K... the next one is a doozie! It was from someone still in college sending me fomulae as to why this battery conversion won't work & recommending that I sell the AA kits. Well... a necessity, but as we all find out post-college in the real world things are not always as we are taught. The proof is in the pudding, as they say. The Stargate jig that I used had this battery conversion installed for 14 years before finally losing mem & the replacement battery that I installed at that time is still working fine some 6 years later. I also have converted bds in the warehouse that have certainly been there more than 10 years & still retaining their mem. Will AAs outlast a lithium in this configuration? Well, as I have said, I'm no battery expert, so maybe they will, but will you lose mem during the same time period, most assuredly. Will they leak & ruin your bd? Again, you can almost bet with certainty that they will.

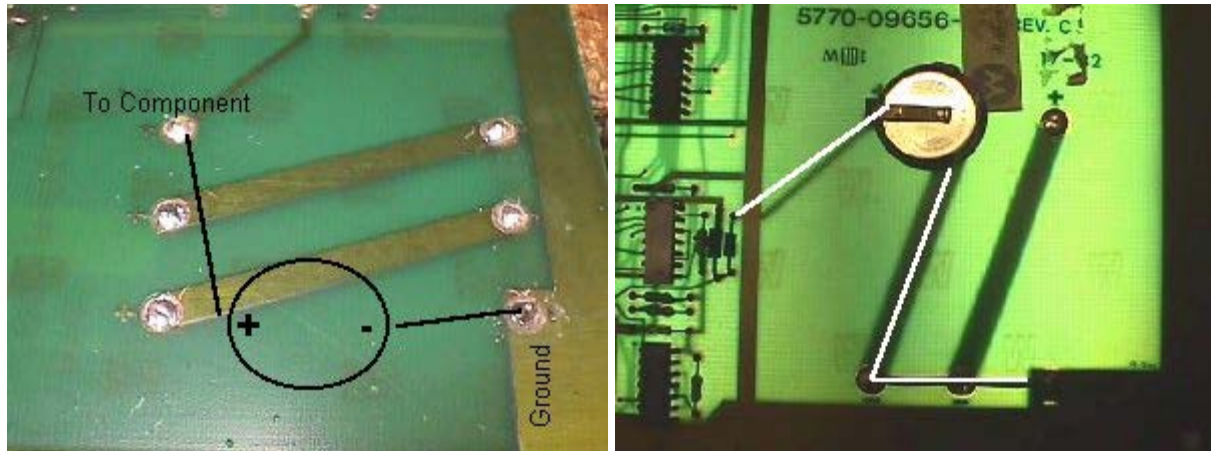
If you install a lithium & it's dead within the next day, or two, just like the AAs, then you have a problem with the circuitry that it powers causing the drain. It's time to dig out the meter & see what's going on. Don't really know what to look for, just find the components that the battery powers when the game is off & clip one at a time out of circuit & look for the battery voltage to climb. More often than not, this will be the ram itself stealing your supply power.

Now I see quite a few emails about the board not looking like the one pic'd in this article. This is just one of the more common of the boards that were used in vid games... Defender, Stargate, Robotron & others of that era. Pin bds are different as are many other bds that can easily convert to lithium. I really didn't think that anyone would have trouble adapting this battery to any bd, especially with the pics showing what they actually do, but I'll give it a shot at simplifying with words... and the pic from above.



This is the simplest circuit that there is in electronics... a battery powering some component. To do that you need the ground terminal of the battery to go to ground [assuming positive voltage is needed]. The plus terminal goes to whatever component you are trying to power. When three batteries are used to total the voltage needed, the circuit needs something to tie the batteries in series for this total...hence the two diagonal wide traces that seemingly go to nothing in the pic above. All that you need to do is locate the trace that goes to the components for the + terminal of the battery holder & then get the - side of the holder to ground anyway you can. In the case above, the - terminal falls right into one of the wide, now unused traces on the board, so it is utilized. This trace drops down to a place that is near the ground strap, so a simple jumper over to

the ground from there completes the circuit. A circuit is nothing more than a complete path from one terminal of the battery to the other.... through a component, of course, otherwise you'd have a short circuit.



You can mount a battery just about anyplace & just run a + wire to the component needing to be powered & a - wire to ground... bd logic ground, not earth ground as some have tried, as this may, or may not be tied to logic ground depending on the usage. This layout is no different than mounting a remote battery in the cab such as was customary with Bally pin bds, Pole Positions & others for protection from acid damage, other than the fact that these were ni-cads that required a blocking diode if you wanted to convert to lithium. Incidentally, I used tubular lithiums in these cases as a cable clamp & a 1/2" screw will mount them wherever you have a convenient spot. You can do the same thing with a ni-cad, but I always put them in a zip lock bag to contain any leakage that might occur.

That's as simple as I can get it... + to component & - to ground. How you get there is inconsequential. Another advantage of the this battery holder & lithium battery is that you can easily change the battery under power without losing your mem.... but that's looking down the road at least ten years.

K... let me ward off one more potential email by saying that all of this is in general terms & assuming common sense is used, e.g., if you were to use your 50 foot outdoor extension cord to get the battery power from it to the component & just coiled it up in the cab bottom, well, chances are you'd only have a tenth of the DC voltage left by the time it reached it's destination. Don't laugh now... I had an op bring a game in with about a 20 foot married pair heavy duty cord doing just that & tangled up all in the bottom of the cab! The battery was lose & swimming with coins, empty chip bags, straws & who knows what else. The darn thing won't keep my bookkeeping for me, he says! Hmmmmm.... wonder why :-)

Happy Gaming.....

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More On Replacing Williams Leaf Switch Buttons

by Bob Roberts

The Labor Day holiday ended a few hours ago & I had hoped to get caught up much earlier in the day to get started on this, but it seems a majority of y'all spent the holiday home working on your projects.

Williams classic games such as Defender, Stargate, Robotron, Make Trax, Joust & others used short leaf buttons on the control panel instead of the typical long buttons when the CP was made of wood. They accomplished this by using leaf switches with a larger than normal molded base & mounting them directly to the wood underside of the CPs with one inch screws.

Note: I've been told by a half dozen collectors in Europe that their versions used long buttons, so I'll put a lead-in pic here of measurements.



The pic above is pretty self-explanatory.



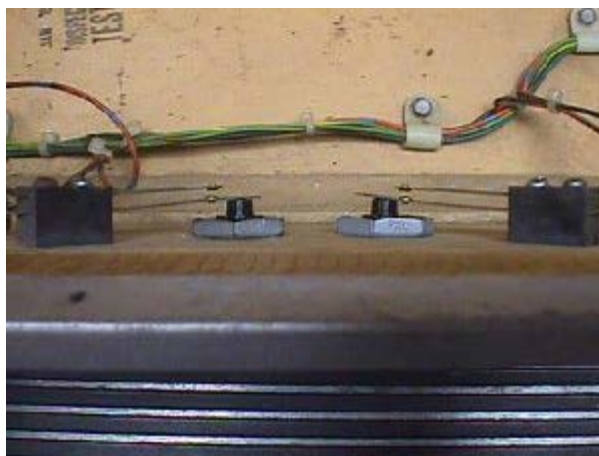
I'm going to use this old Make Trax CP since it only has two buttons.



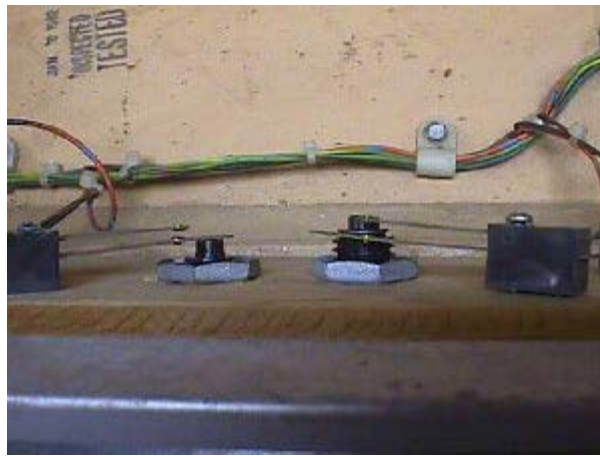
You can see the switches mount directly to the wood underside.



Notice how much thicker the molded plastic base is compared to standard leaf switches.



You can see the short buttons barely protrude through the wood.



Here you can see a long button on the right & if you look at the leaf switch you can see that the button is much higher, although this didn't stop many ops back in the day as they would just bend the blades up on a twenty to thirty degree angle if they didn't have the short button.



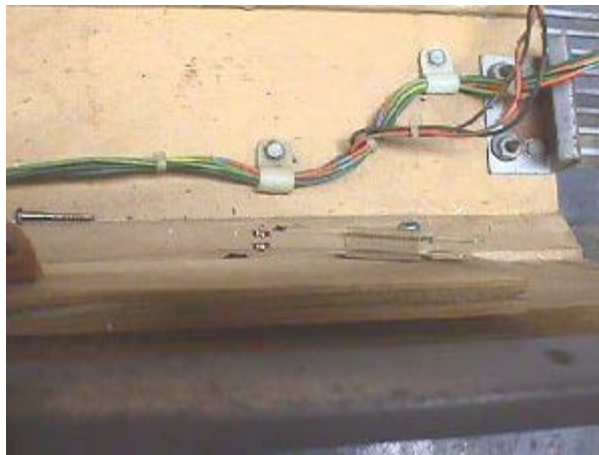
If you want to use long buttons the easiest & most aesthetic way is too use the newer leaf switch with the wood mounting nylon holder.



Too costly... you can shim up the switches with either a small piece of wood under each one or make an appropriate shim across the whole button field drilling the 5/8" holes for the long buttons to come through. The pal nuts will hold your full shim in place, so there is no need to nail, screw or glue it down. You may have noticed that Home Depot supplies free shim material of the right size :-)



I used a fiber leaf switch above clamped to a Williams leaf switch clearly showing the difference is almost double the body thickness.



If you need to replace leaf switches & cannot find any of the obsolete WMs type in good used condition, and you don't want to use the newer more modern holder combos, you can use standard sized leaf switches with either long or short buttons by varying the thickness of your shim material.



Naturally, the large pieces of shim material are only for demonstration purposes & you'll have to come up with your own layout per CP whether it be for small single pieces or a couple larger multi-switch pieces.

I intended to do more here, but all my pics did not turn out well & time is

spread pretty thin, so it'll have to do.

Happy Gaming...

WMs Coin Door Lamp Circuit

by Bob Roberts

Although there are several FAQs about the converting of a Williams linear power supply to a switching power supply, I am still asked about the lamp circuit frequently after the installation of one my plug-n-play conversion kits.

I glanced through a couple of the FAQs & saw that they recommended doing something that I would not do personally, so I thought I would add my version & the reasoning behind my choices here.

They recommend removing the wires from the AC transformer supply for the coin door lamps & running one to ground and the other to either the -5 volts or +12 volts on the switcher [1813 lamps must be used for 12 volts] and both did not mention fusing this line, which theoretically is acceptable since the switcher will have short protection 99% of the time. Now if you have a cab with no original transformer or linear power supply installed, I guess I would be forced to go along with this method, with the addition of new lamp sockets that were well insulated, but should you have the original transformer installed in the cab, I would recommend using it.

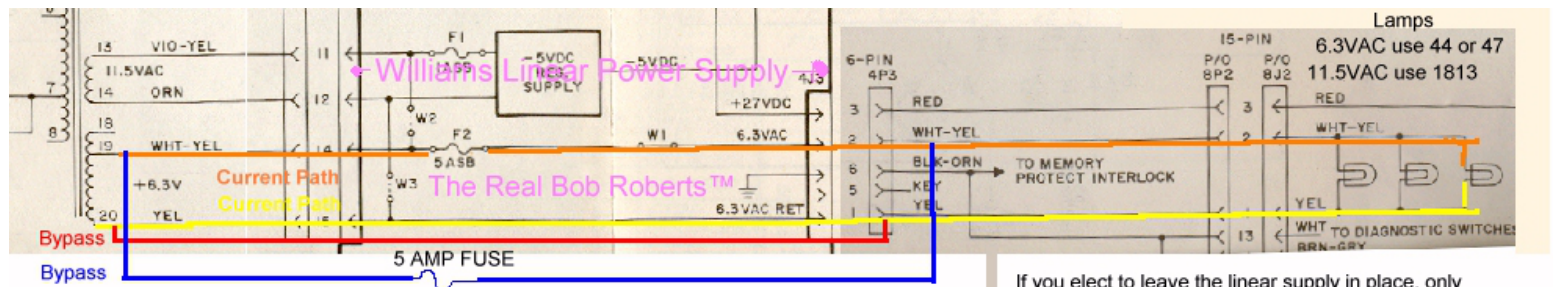
Why? My first thought is because it is there, but secondarily I look at the failures that occur when the short protection circuits are over used, and then I look at a known failure of the WMs coin door lamp holders... as they age the terminals tend to spin & short to one another... and I have to think that it is much more prudent to change a fuse rather than a switcher, or at a minimum removing & repairing it (time consuming).

Yes... I know the critics will say you have short protection, why not use it? My best analogy would be that you all have emergency brakes on your automobiles, but would you choose to use them instead of your foot brakes? I'm no auto mechanic, but I don't think this would be a good practice. The short protection circuit is there to protect you from that once in a lifetime... hopefully... mysterious short that arises & not for encore performances on a regular basis caused by faulty lamp holders.

I would much rather keep the isolated & fused AC supply from the transformer feeding these coin door lamps... the only reason for the existence of this xformer winding:(Ok... so you don't have the original power supply in the cab... where the fuse holder was so wisely mounted for the coin door lamps :(Well move it! Not literally... just install another fuse holder in the cab bottom, or use an in-line fuse holder with the wires already attached for you, to relocate the fuse & holder to a more suitable home.

Note: A very common mistake that lots of people make is always blaming the transformer for voltage problems. The reason for this is because usually the common meter lead is put on ground in the cab to take measurements to the terminals & then compare to voltages on the schematic. News flash.... AC (alternating current) is not measured from ground as DC voltages are, but rather between the 2 terminals of the winding being measured & with the meter set to AC voltage... not DC voltage. [Not sarcasm...impact :)]

That said, the pic below shows the AC path from the transformer to the lamps, and only the lamps.... the sole purpose for this winding... via the yellow line & the orange line. You'll note that the yellow line simply enters one side of the original power supply & goes directly across the pcb to the opposite side where it continues on to one side of the lamps. The orange line makes one brief stop to go through a fuse holder & then continues on to the opposite side of the lamps thus feeding 6.3VAC to each of the lamps. The red & blue lines show how to bypass the OEM PS & feed the coin door lamps with the PS removed from circuit. You can solder the bypass wires to the transformer at the numbered & color coded positions & line tap them beyond connector 4P3 as indicated. You could join the wires to the terminals of that connector if you have some new .156 terminals. Don't forget.. the blue line has to go through the added fuse holder.



After installing a new switcher in a WMS Stargate on up, you can relocate your fuse to the cab bottom, so that you can continue to supply a fused AC source for your coin door lamps. This will keep your switcher from going into shut-down if the lamp holder contacts are accidentally shorted together. The Defender transformer does not have this 6.3VAC winding, but rather uses the winding at 13 & 14 to supply 11.5VAC. To correct for this, you can put a 2 to 5 ohm 5 watt resistor in-line, or simply change lamps to # 1813.

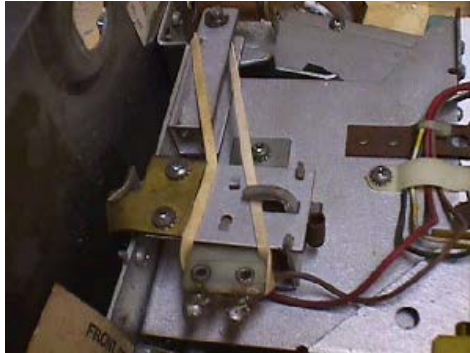
If you elect to leave the linear supply in place, only removing the plug 4J2, moving the fuse is not necessary. Using this bypass system allows you to install either PS. If using the linear, be sure to unplug the AC line to the switcher. I would cut the 27VDC line in either case, and put rubber bands around the coin lockout armatures to alleviate the heat.

Note: Some Williams' games route the control panel ground &/or coin door ground through the memory protect ground return which makes physical ground through the header 4J3 on the linear power supply, and in these cases, if the linear is removed from the cabinet, then you will have to physically tie the ground loop to a known good ground line. Barring all else, you can run a new ground line all the way back to the switcher's spare ground terminal, or simply run a jumper from the spare ground terminal to 4P3P6 on the removed plug.

Tip: The pasted together diagram above should also answer another common Q... Why does the 5 amp fuse F2 keep blowing out on my power supply? Well.... from this you can see that it only fuses the coin door lamps, hence if it continually blows you have either the dreaded lamp holder/s shorting their terminals together, or you have a wire shorting to the metal someplace... usually around the coin door hinge where it can be pinched & nicked when closing the door.

FAQ

> I have the *silver* coin door on my Defender with one lockout coil that activates a rod that controls all three coin mech lockouts. How do I use a rubber band on this?



While on the subject of the Williams power supplies I may as well express my humble opinions about them, once more, as it has been a few years since my postings to the newsgroups and there are many newbies to the hobby now. As most of you avid collectors know already, I think that these are a great linear power supply & have always repaired them even when installing a switcher, having the best of both worlds. I've heard the complaint about how the power supply ate up your rams... yes they are extremely power sensitive utilizing 3 different voltages... but... what is forgotten is the fact that these supplies were work horses for 20 years with little or no maintenance to speak of! If the game was working & taking in those quarters for it's owner, then there was no need for servicing them, right?? Well.. as a result of this lack of attention over decades, the headers are often broken free from their pads causing an intermittent delivery of power to the boards. This periodicity of power being applied to the boards is what damages (eats up) your rams... not anything that the power supply is to blame for, & had it had some preventative maintenance over it's lifetime, it would still be ticking strong.

It looks like some 500, or so, linears have been restored to good health over the past 4 years with my rebuild kits, but as I'm typing this, I am thinking about redoing it to include the pot that I installed on all of mine to adjust the 5 volts. I did this because ops continued to, and still do, use these linears to power later games through Jamma to date. When putting together kits for repairing them, I didn't think this would be necessary for use in the cabinets as designed for, but in this millennium we have seen the desire to run multi-games in Williams cabinets, so I think it prudent to include the pot & instructions along with the 4P1 Molex connector that so often burns up as a result of these ringed header pins. Most kits were accompanied by WMs OEM PS connector kits, but I think that if the 4P1 were part of the repair kit it would save you from having to do the others in most cases, and although it would cost slightly more, the savings from having to buy a connector kit will more than make up the difference.

I will try to find the time to document the addition of a pot to control the 5 volts with pics here.... perhaps on the next holiday :) I'm reminded of a recent email about the kits & I'll post it here along with my answer as it may help others. Edited, of course, to protect the innocent:)

Q. I have a question for you. I just installed one of your Wms OEM PS Connector & Repair Kits in a Defender and am experiencing a problem that I have not seen before in a Williams game. Please do not think this email is a complaint in any way but rather I am trying to understand what is going on as I have installed your kit before, several times, and this is the first time I have seen this.

Sym. First off I have checked all the voltages after installing the kit and they are right where they should be. Now the problem I am experiencing is a horizontal hum bar from top to bottom when the game is powered up. From there I get the normal rug pattern then a Ram Error and the machine reboots. If I swap in a known working power board, the hum bar goes away and the game plays normal. Any ideas?

A. Check list:

- 1 I know you didn't install anything backwards so goto 2 :)
- 2 Check all installed component spews (ends you cut) to make sure they have continuity from them to the next component in all directions. Looking for an open from pad to trace.
- 3 Carefully look the board over for solder spills/splashes that may be shorting two points that should not be.
- 4 Carefully examine all header pins not only for good pad to pin connections, but also connector pin to header pin, as sometimes the header pins will have a bit of corrosion on one that is hard to see, but which prevents a stable connection.
- 5 Maybe time to go back to your day job if you started with a working board :([said jokingly]

If I had to guess in the blind... I'd say you have a bad connection at the 2N3055.

Reply. Your guess was correct. The 2N3055 was not seated properly underneath the heat sink.

Note: This is a very common problem with TO3 (bottlecap) transistors in monitors, power supplies & other PC boards & is due to the fact that the collector gets it's connection through the mounting screws. Always be sure that they are tightened down securely.

Happy Gaming.....

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Williams Decoders

General Problems & Solutions

by Bob Roberts

These are a few of the simple things that I found when investigating why some were having troubles using the 2716 eproms in place of the Williams decoder proms. Most of them are just general things that apply to other games, as well, so this is long overdue.

A few feedbacks that I got were that one of the two 2716 eproms loaded with the decoder program would not work, but putting the prom back in place of the non-working 2716... 1 2716 & 1 OEM prom... would result in the board working. No pattern... might be rom 4 position on one bd, while rom 6 position on another.

I didn't run into this problem in going through a stack of my own bds, but in checking the bds that people had given up on, I found that they did not work on my jig, either. The problem was a common one found wherever sockets have been in use for years. First off, the sockets that were used most often in the early games were single wipe sockets, meaning that the wipe surface inside the socket only made contact with the inside of the IC's pins. Now given the age of the sockets & the attempts over the years to put ICs in with bent legs, forcing the wipes closer to the outside of the socket housing, and you see that the replacement has the odds against it at the get go.



Sometimes the wipes are bent so far in that you can see it without removing the cover. One of the notorious places for this phenomenon can be found on the Pac bds where the sat bds have been inserted into the sockets without the benefit of the intermediate adaptor socket.

Another factor is that the proms that have been residing in these sockets for all these years have corroded, welding together a pin or two to the wipe/s. When you remove the prom & break it free from the wipes, they will sometimes not make contact to a new eprom, but mate up to the OEM prom when reinstalled.

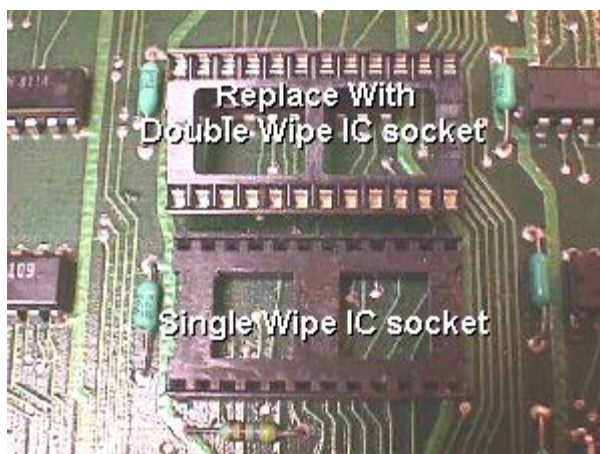
Now, as if this is not a strong enough current to swim against, then the new eproms are shipped with the pins flaring outward... away from single wipe sockets :-)



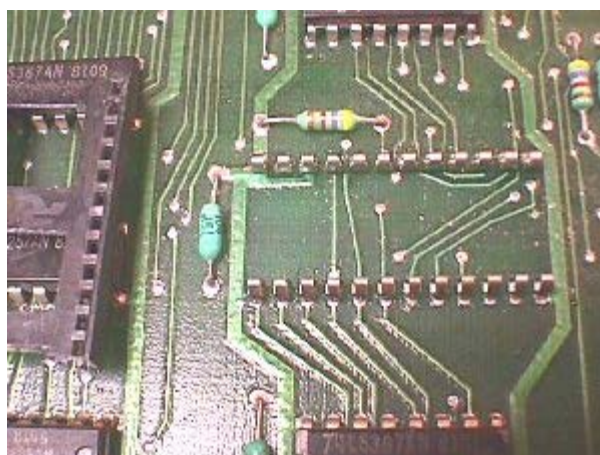
K.... this one I solved right away by making sure that I straightened the pins with my *IC Pin Straightener* before shipping, since most do not have one of these at their disposal. I do this for almost all ICs shipped to prevent a possible headache. There is a smaller hand held version on the [Parts Page Tools](#).



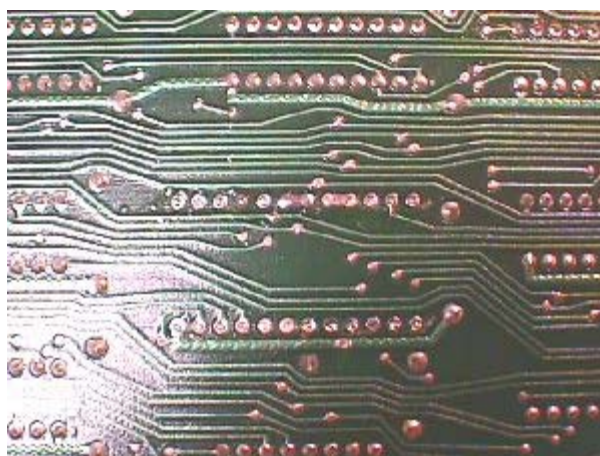
As for the sockets themselves, that's something that has to be taken care of by you....replacing the old single wipe sockets with the dual wipe sockets that make contact on both sides of the IC pins.



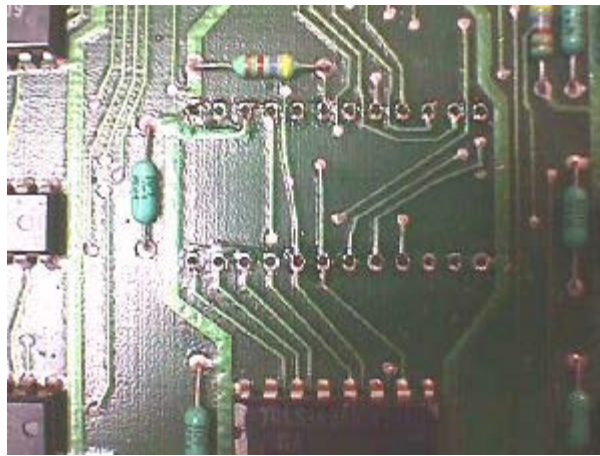
You can readily see the difference in the 2 type sockets & how the dual wipe will ensure that contact to the pins of any IC will be steadfast.



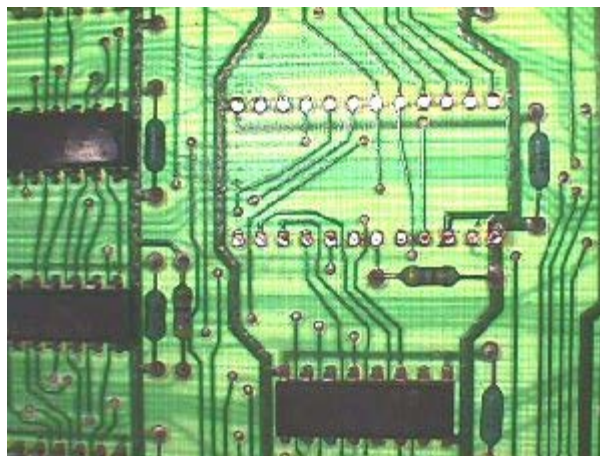
The Williams board has thin traces & small through holes, so normal precautions must be taken when replacing these sockets. I'll go over the basics here again just to be sure. Don't stay heating a difficult solder joint to clean too long... revisit any stubborn ones. The best way I've found to ensure that you do not damage the bd is to incorporate a little help from the boss. Get her standing by with a pair of needlenose pliers. Remove the IC socket cover... gently prying up on it while making sure that you don't damage something else on the PCB. Then reheat the solder joints (solder side of the board) by adding new solder to each socket pin.



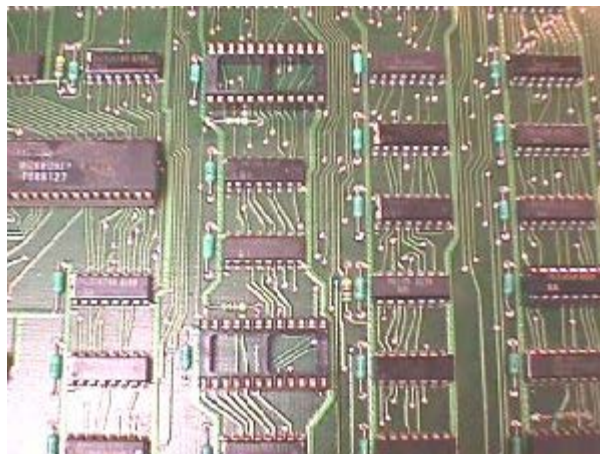
Now show the boss which pin you are going to start with & tell her to hold on to it with the pliers while you heat up the solder joint. It'll pop right out for her & she can deposit it into an ashtray or other receptacle & then move to the next pin in line.... and so on until all pins are gone. Next... start at the first pin hole & reheat, use a solder sucker to clean the hole & continue until all holes are clean.



You can hold the PCB up to a light to be sure that you can see through each hole before attempting to place the new dual wipes in them. Also, be sure there are no solder splashes or any excess solder on either side of the board.



After setting the new sockets, paying attention to placing the notched end correctly, just tack 2 opposite corners so that you can look it over before soldering it in completely. Make sure all pins are coming through & none are bent or missing.



You should end up with sockets sporting their metal teeth proudly like the ones above :-). Take one last look-see around the sockets to make sure everything is good to go.

Moving on to the next issue. It seems that the eproms are less voltage

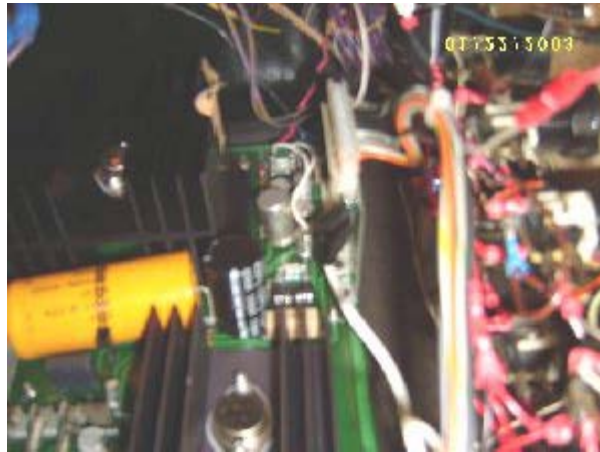
forgiving than the OEM proms. This is not a problem with games with switchers already installed as all that needs to be done to correct the problem is adjust the 5 volts up a little higher while monitoring the voltage at the main bd or rom bd.

In tests that I performed on my jig I found that the proms would keep on ticking even when the 5 volts was lowered to 4.35 volts & they would even enable when reset at this low voltage. The eproms, however, would not operate below 4.7 volts & at 4.7/8 volts would not enable upon resetting. They need a good 4.85 volts in order to keep on ticking like the older proms.

The reason that I did these tests was because a local tech had put a board in a customer's game & it did not power up. He brought the board to me & we put it on the jig & found it worked great. My jig has the option of using the original WMs power supply, so I swapped from switcher to the OEM PS. It still worked fine, so I told him to put it back in the game & check the voltage on the rom bd. As it turns out, he measured only 4.5 volts in his customer's game that had the OEM PS, but it was not one that had been through my shop, so it didn't have the 5 volt adjust added to it, leaving him with no way to correct it. I had him yank the PS & I modified it for him... problem solved.

This is one of the few board hacks that I would do, but it is not needed when used with all original equipment. It's only needed when the PS is used to power JAMMA game bds, or just later pre-JAMMA bds, and, of course, if you've modified the OEM WMs bd in a manner such as using the 2716 decoders... if they will not operate without the mod.

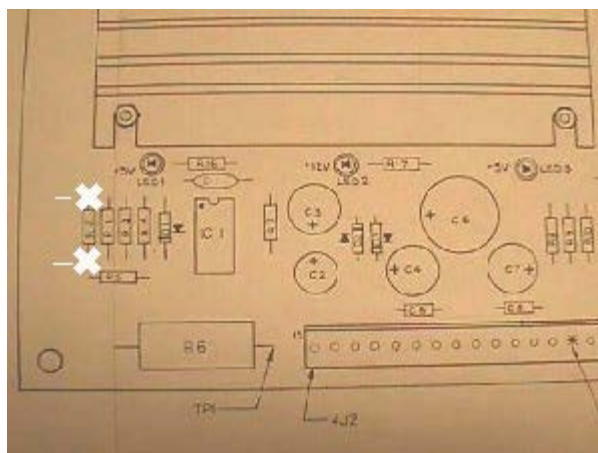
I don't have any Defender power supplies left to illustrate the mod, but it is a simple one only requiring that R2 be replaced with a 5K pot. Just set the pot to midrange & adjust with a meter after powering up. My linear supply is mounted under the monitor on my jig, but I will try to get a pic of it to place here.



Well.... as it turns out, my Sony didn't want any part of capturing a pic up in this dark hole under my jig monitor, so I used Alice's camera with flash... upside down & without being able to see what I was shooting. It didn't make for the best pics, but hopefully you get the drift of things.



This particular one on my stationary bench jig is wired into a 5K pot mounted on the control panel along with a 12 volt analog meter for monitoring the output at a glance. The white married pair of wires simply take up residence in the thru holes where the R2 resistor was removed and then the other ends tie to one side & the center tap of the mounted 5K pot.



Maybe this layout pic from a manual will point out R2 a little better than the fuzzy pics :-()

As the WMs power supplies came thru the shop... back in the day... I made the mod on board by using a 5K thumbwheel in R2 spot leaning to the left, braced & stabilized with a gob of hot glue.

Well... it's taken me somewhere between 5 to 10 years to get this finished & posted, so I sure hope some of these general solutions & tips will be of use to hobbyist.... at least a couple :-()

The next article I plan on finishing is on the cheap audio amplifier that I have explained in email at least a hundred times over the past 10 years with mixed results, some get it, some give up, so it's time to put some pics to the project enabling more people to get it.

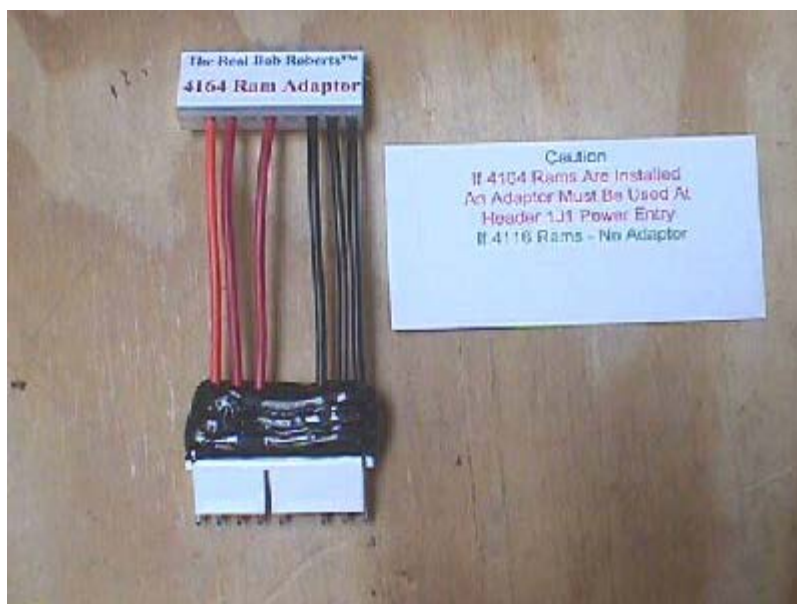
Hmmmmmm.... I kept a daily journal during Katrina down time devoting a minimum of one hour a day... some days 3 or 4 hours... and at the rate I'm going I probably won't live long enough to transcribe it :-() Maybe I should learn to type faster :-)

Happy Gaming...

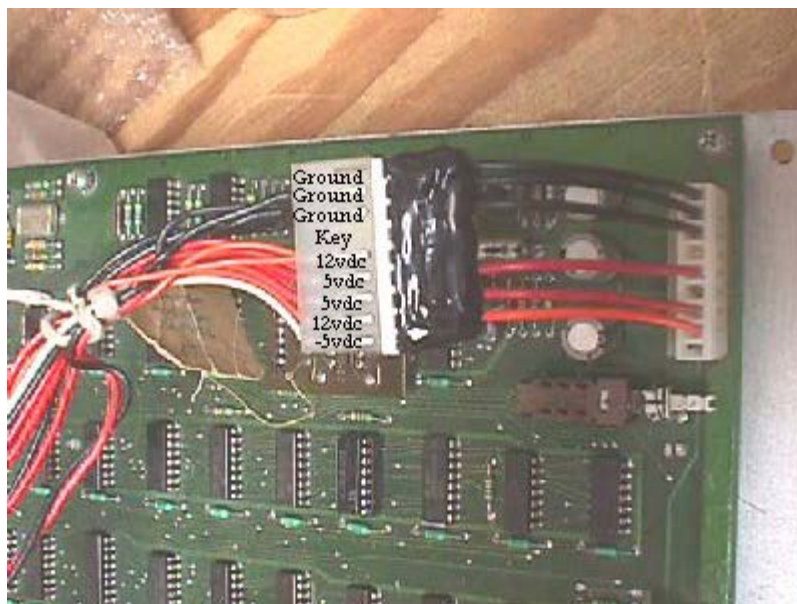
[Site Index](#) - [Big Bear's Bulletin Board](#) - [Parts Page](#)

Williams 4164 Ram Adaptor

by Bob Roberts

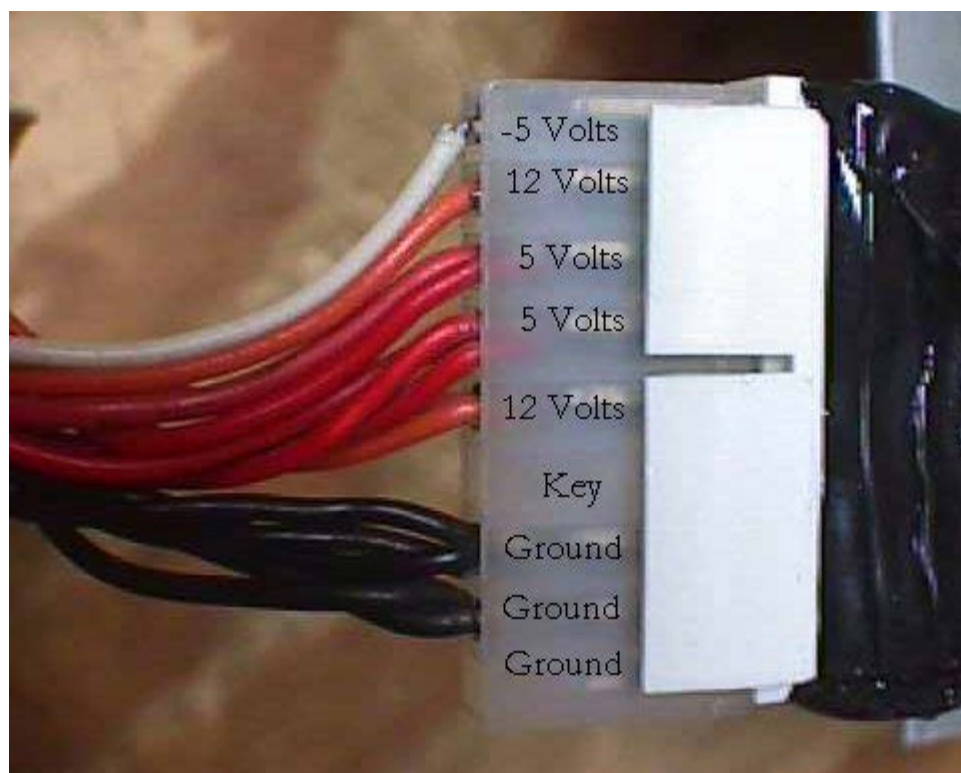


This is how the adaptor should look. Due to several laypersons postings online saying that wires were missing and that they had to cut into the connector & add wires, several have followed that with some bad results. These adaptors are correct & have worked for decades without any problems at all left in their original condition. They are flawless with their keyed self alignment. If you modify these in any way you risk cooking dozens of ICs. The adaptor should only be used when populated with 4164 rams & removed if you wish to use the original 4116 rams. The label that comes with the adaptor should be applied to the board to prevent any problems in the future.



The pic above is of my Stargate test jig with adaptor & for some reason I'm asked for the pinout every couple of weeks, so I'm going to label it on the pic. I looked at a pic sent to me this AM with a homemade WMs harness using an 8 position IL connector. This is a good way to get into

trouble, especially if there is no polarizing key. The 12 volts can accidentally be applied to the 5 volt chip feed line.



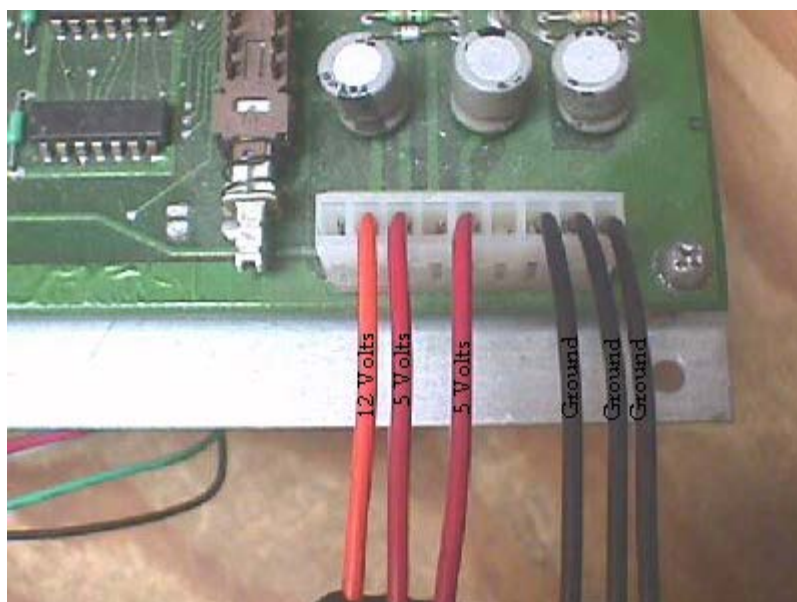
Going away from the game board & a closer pic.



Not all lines carry through to the game board since this is the purpose of the adaptor... to eliminate the voltages that would fry the 4164 ram field. This is accomplished without any hacking to the board itself. Adaptor in place...4164 ram, no adaptor the needed voltages for the 4116 ram field is supplied.



Hence the importance of affixing the label to the game board! Even our test jig boards!



Happy Gaming.....

[Help Page Index](#) [Big Bear's Bulletin Board](#) [Site Index](#)

Simplified WMs Svc Sw Bench Jig Wiring

Upper Middle Sw
Blue Wire To Rom Bd 2J3-1
2 Outside Sws Looped With
Grn Wire To Rom Bd 2J3-2
Middle Posts Tied Together With
Black Wire To Rom Bd 2J3-10

The Real Bob Roberts

On The Bench The Advance (Green) Is Looped To Both Outside Switches For Convenience In Testing. This Type Switch Assembly Often Confuses Newbies. It Is Actually 2 Switches For Each Unit Giving You A Total Of 6 Switches. When All 6 Middle Posts Are Tied To Ground You Have 12 Different Possible Combinations Of Switching. Each One Of The Upper Post Will Close To Ground In The "UP" Position & Open In The "DOWN" Position. Each Lower Post Will Close To Ground In The "DOWN" Position & Open In The "UP" Position. Of Course, Each Pair Per Unit Work Simultaneously Hence The Need For 3 Units.

XY Transistors Shorting?

by Bob Roberts

The main reason for the xsistors blowing is poor connections from their physical location on the frame to their destination on the chassis. The [harnesses](#) to each pair should be eyeballed & even checked for continuity as often times a pin will be connected, but by the insulation only & not the wire. The ends that are soldered to the sockets should be examined closely, as well. You should be sure the xsistor mounting screws are tightened properly since they are what connects the xsistor collector to the circuit. If your header connectors are the red MTA type be aware that they have been a known source of bad connections that have plagued the industry since their inception. Another problem with those MTAs, & other connectors, is a feature that many think they require... the ramped version. How the ramped version works is that the ramp & the counterpart ramp on the header lock together when plugged up. Seems like a winner... the connector can't work it's way loose & come off... but over time this action rings out the solder joints on the header causing intermittency & in turn short out the output xsistors. The headers need to be inspected & resoldered if necessary... which is almost always!

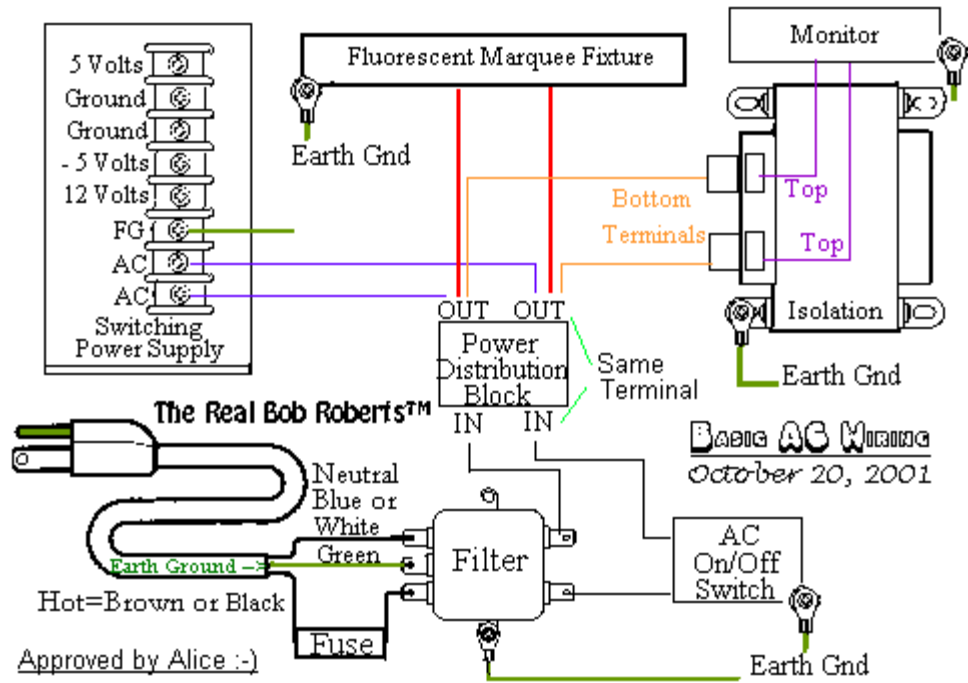
The short check list:

- 1 Check output xsistor harnesses.
- 2 Check connections to the xsistor sockets.
- 3 Check connections to the chassis header connectors topside.
- 4 Check connections from the chassis to the header bottomside.
- 5 Check xsistor mounting screws for proper tightness.

Over the years I've heard hundreds of ops, hobbyist & even techs say they got bad xsistors from this place or that place because they shorted right out immediately & maybe even did more visible damage. I've had techs say they changed out xsistors with huge overkill xsistors & they solved their problem! NO they didn't & the bad rap for the 2N3716/2N3792 escalated. The problem was in lack of due diligence. Putting in a pair of xsistors that could take a couple hundred volt spike & keep on ticking only masked the problem that may be exacerbated down the line.

The 2N3716/2N3792 pair are well equipped to handle the job in any of the XY monitors, but like any other components they need to have solid, stable connections to the rest of the circuit.

Happy Gaming...



The Real Bob Roberts™

New JAMMA Pinout & Colors

PARTS SIDE			SOLDER SIDE		
Black 18ga	Ground	1	A	Ground	Black 18ga
Black 18ga	Ground	2	B	Ground	Black 18ga
Red 18ga	+5 volts	3	C	+5 volts	Red 18ga
Red 18ga	+5 volts	4	D	+5 volts	Red 18ga
Blue 18ga	- 5 volts	5	E	- 5 volts	Blue 18ga
Orange 18ga	+12 volts	6	F	+12 volts	Orange 18ga
NA	Key	7	H	Key	NA
Yellow	Coin Counter 1	8	J	Coin Counter 2	Yellow/S
Gray	Coin Lockout	9	K	Coin Lockout	Gray/S
Violet	Speaker +	10	L	Speaker -	Violet/S
Blue/S	Not Used	11	M	Not Used	Orange
Red	Red Video	12	N	Green Video	Green
Blue	Blue Video	13	P	Composite Sync	White
Black	Video Ground	14	R	Service Switch	Orange/S
Red/S	Test	15	S	Tilt	White/S
Brown	P1 Coin	16	T	P2 Coin	Brown/S
Gray	P1 Start	17	U	P2 Start	Gray/S
Blue	P1 UP	18	V	P2 Up	Blue/S
Green	P1 Down	19	W	P2 Down	Green/S
Yellow	P1 Left	20	X	P2 Left	Yellow/S
Red	P1 Right	21	Y	P2 Right	Red/S
Orange	P1 Button 1	22	Z	P2 Button 1	Orange/S
Violet	P1 Button 2	23	a	P2 Button 2	Violet/S
White	P1 Button 3	24	b	P2 Button 3	White/S
Green/S	P1 Button 4	25	c	P2 Button 4	Black/S
Brown	P1 Button 5	26	d	P2 Button 5	Brown/S
Black	Ground	27	e	Ground	Black
Black	Ground	28	f	Ground	Black

Outside Color=Bundle | /S=Striped

Yel=Power|Gray=Coin Door|Violet=Speaker|Green=Video

Pink=Player 1 | Aqua=Player 2

ID By Pic Aid

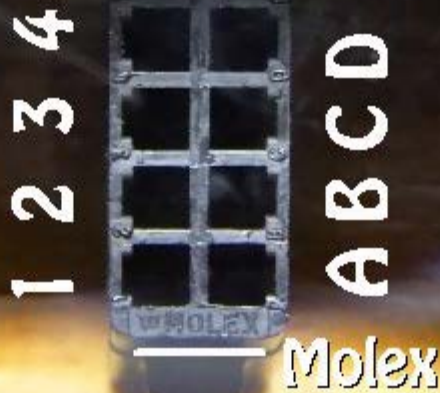
I put this pic up for the January sale & got two comments right away expressing how it helped them ID a part or two that they had been looking for, so I decided to relist these items here along with the pic just for ID purposes.



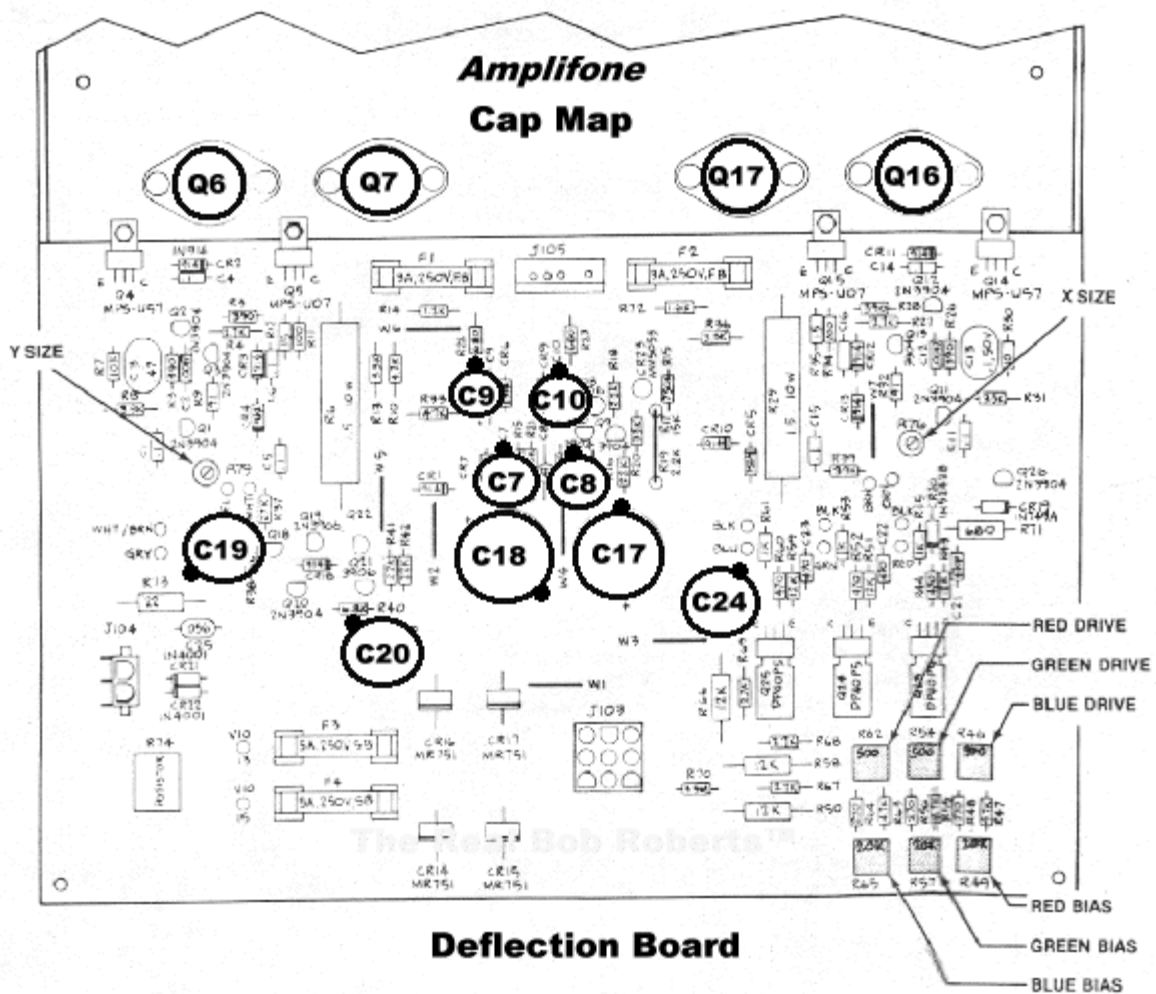
Bag Of 100 4" Natural Cable Ties (#1)	\$2.00
Bag Of 50 .110 Quick Disconnects (#2)	\$4.00
Bag Of 100 Red Partially Insulated .187 QDs (#3)	\$6.00
Bag Of 100 Red Partially Insulated .25 QDs (#4)	\$6.00
Bag Of 50 Red Fully Insulated .187 QDs (#5)	\$6.00
Bag Of 100 Red Fully Insulated .187 QDs (#5)	\$11.00
Bag Of 500 Red Fully Insulated .187 QDs (#5)	\$47.00
Bag Of 50 Blue Fully Insulated .187 QDs (#6)	\$7.00
Bag Of 50 Red Fully Insulated .25 QDs (#7)	\$7.00
Bag Of 50 Blue Spades (#8)	\$6.00
Bag Of 50 Crimp Wire Nuts (#9)	\$5.00
Bag Of 50 Red Quick Splicers (#10)	\$7.00
Bag Of 50 Blue Quick Splicers (#11)	\$7.00
Bag Of 50 Black Cable Clamp Screws (#12)	\$2.50
Bag Of 50 Stainless Cable Clamp Screws (#13)	\$2.50
Bag Of 100 3/8" Cable Clamps (#14)	\$5.00
Bag Of 100 1/4" Cable Clamps (#15)	\$5.00

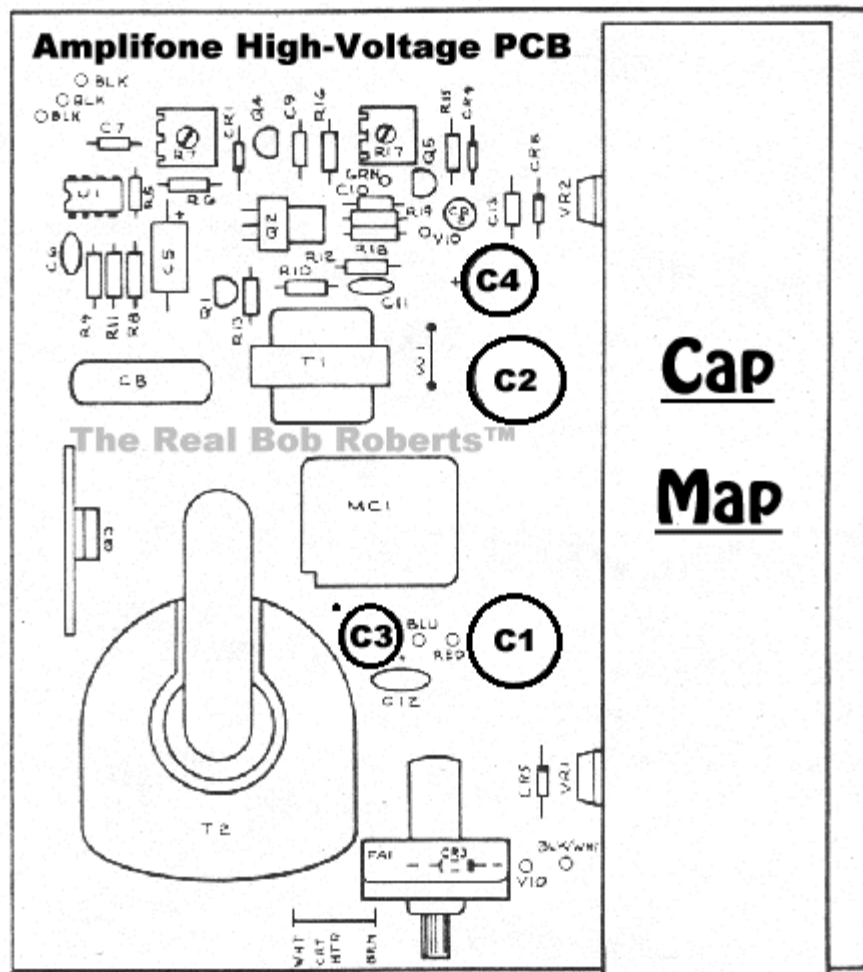
Bag Of 100 3/16" Cable Clamps (#16)	\$5.00
Bag Of 100 1/8" Cable Clamps (#17)	\$5.00
Bag Of 100 #8 Red Rings (#18)	\$6.00
Bag Of 100 #10 Blue Rings (#19)	\$6.00
Bag Of 100 Blue Partially Insulated .187 QDs (#20)	\$6.00
Bag Of 50 Blue .25 Partially Insulated QDs (#21)	\$4.00
Bag Of 100 Blue .25 Partially Insulated QDs (#21)	\$6.00
Bag Of 25 Blue .25 Fully Insulated QDs (#22)	\$5.00
Bag Of 50 Blue .25 Fully Insulated QDs (#22)	\$8.00
Bag Of 100 Blue .25 Fully Insulated QDs (#22)	\$12.00
Bag Of 500 Blue .25 Fully Insulated QDs (#22)	\$48.00

Molex Split Pin Housing ID



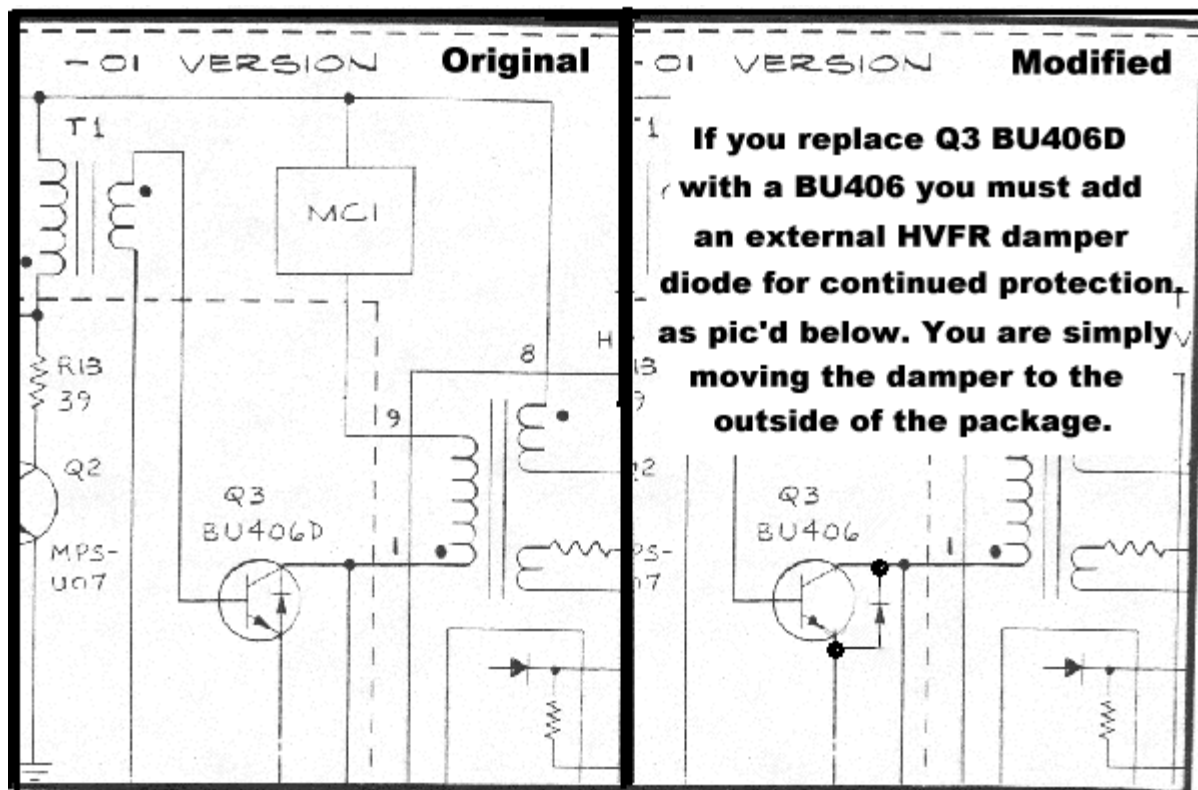
Pic Looking Through A Magnifying Glass
The Real Bob Roberts™

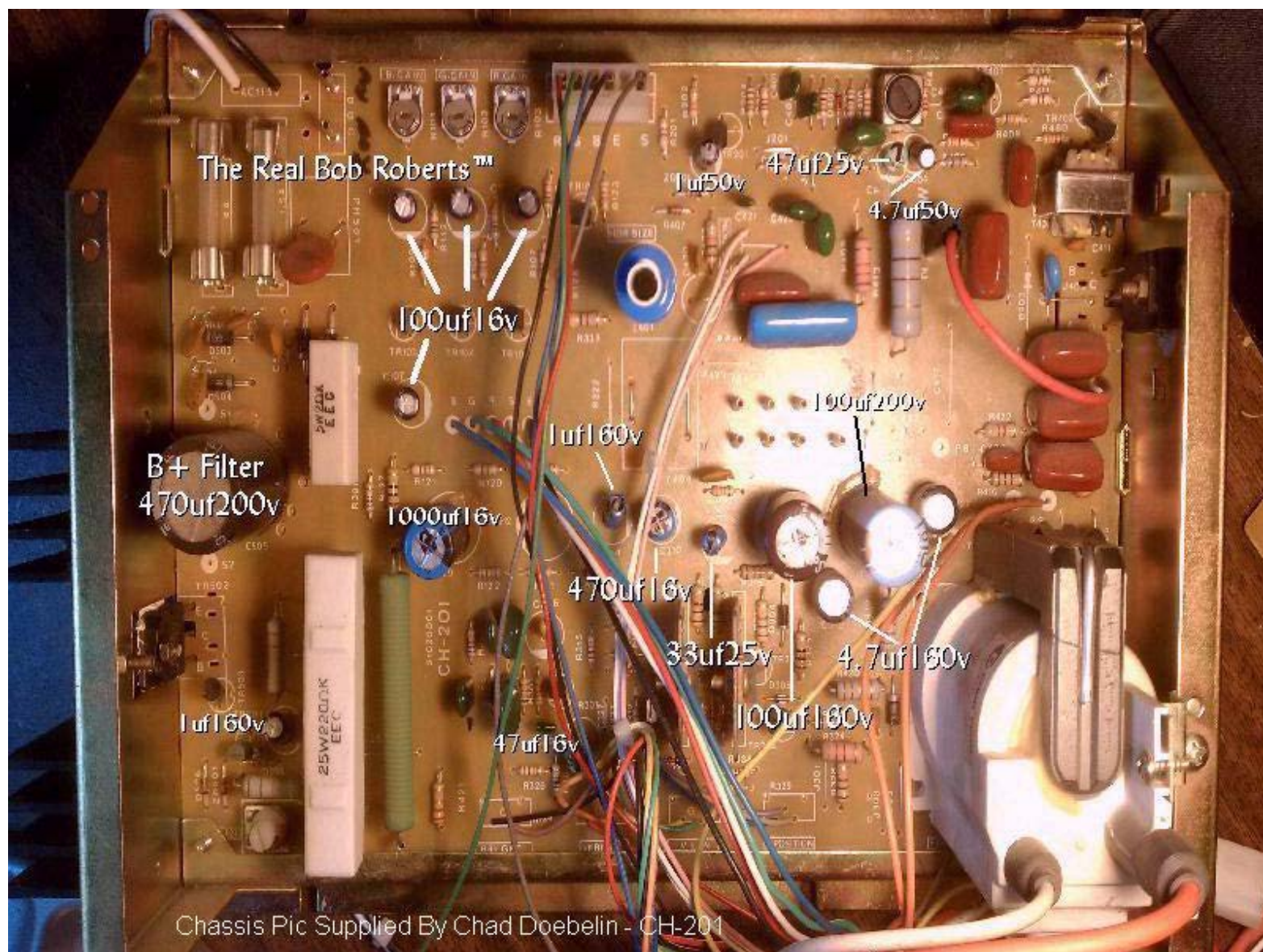




Cap

Map





Chassis Pic Supplied By Chad Doebelin - CH-201

This Chinese chassis has been around for a good many years & hopefully my Cap Map© will help you to get a cap kit for your like chassis no matter the name brand you find on it. First versions will not have remote adjustment boards, but rather the controls mounted right on the main chassis. Cap positions may vary slightly, but in general will conform to the above layout. You may find some variations on values with your particular chassis & this can be accounted for by servicing over the years. Also, mfrs often up values in mid-production due to shortages or an over abundance of the next higher voltage value, i.e., a diminishing stock of 1uf16v & an overstock of 1uf25v may result in half the chassis' shipped with one value, while the other half will ship with the other.

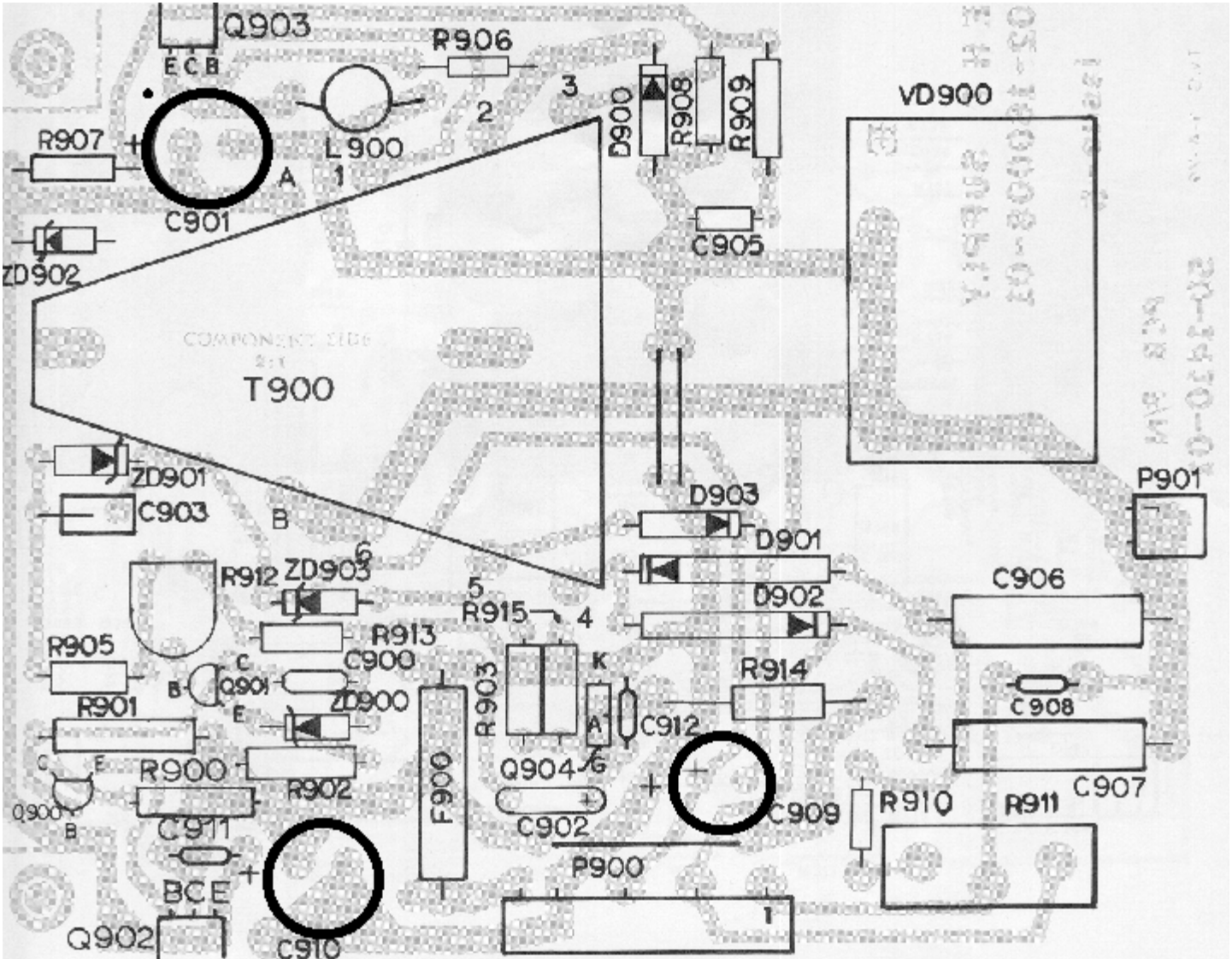
The first versions showing up at our service center were strictly labeled in Chinese and shortly thereafter a host of brand names were affixed. I'll list a few references off the top of my head, but I'm sure there are many more... some that we probably never saw here in the south. They sported labels such as Eago, Eygo, Jin Ruey, Chun Peng, Promax, Pentranic & a host of others. Unfortunately, they position numbered the caps from chassis to chassis version from slightly different to almost entirely different. For this reason we have put together a kit of these caps without position numbers & have called it simply the CH-201 cap kit after the one pic'd here at a cost of \$7. Your chassis may not be stamped at all or with M-703 or a host of others.

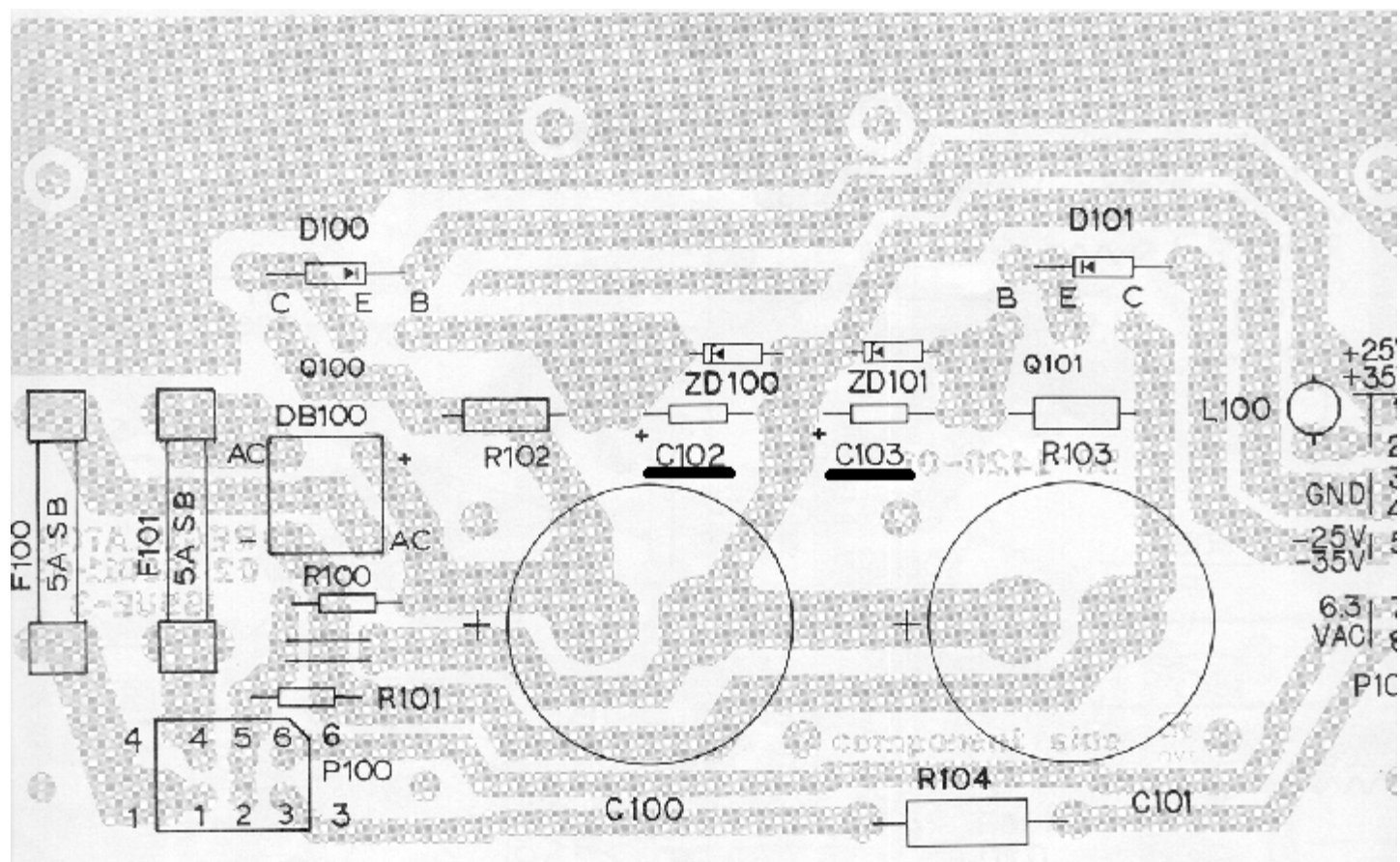
- 1uf50v
- 1uf160v x 2
- 4.7uf50v
- 4.7uf160v x 2

33uf25v

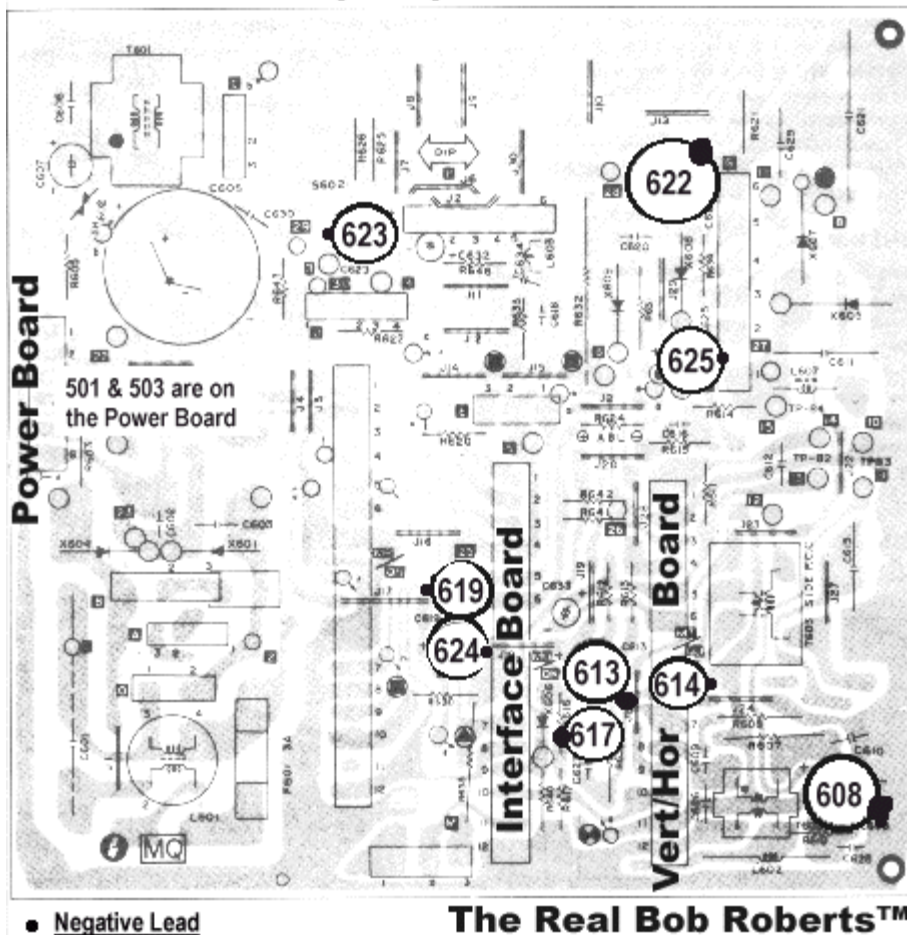
- 47uf16v
- 47uf25v
- 100uf16v x 4
- 100uf160v
- 100uf200v
- 470uf16v
- 1000uf16v

The chassis uses a 470uf200v B+ filter that can be bought separately if needed for \$4.

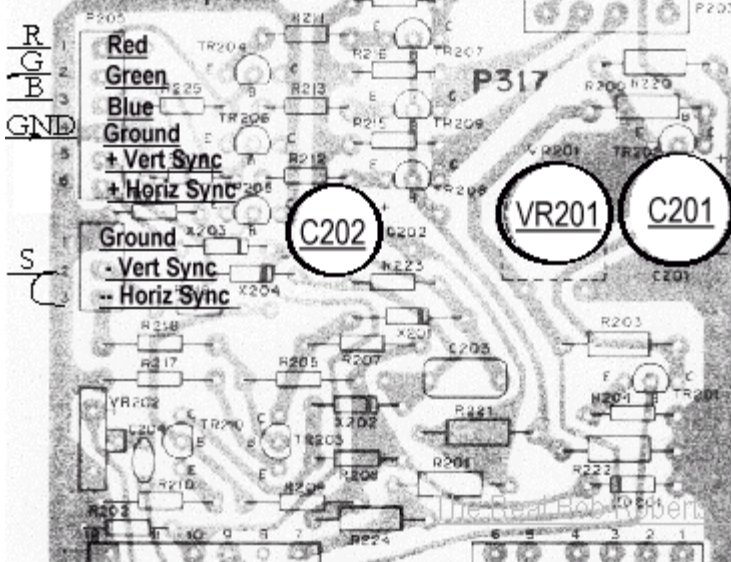




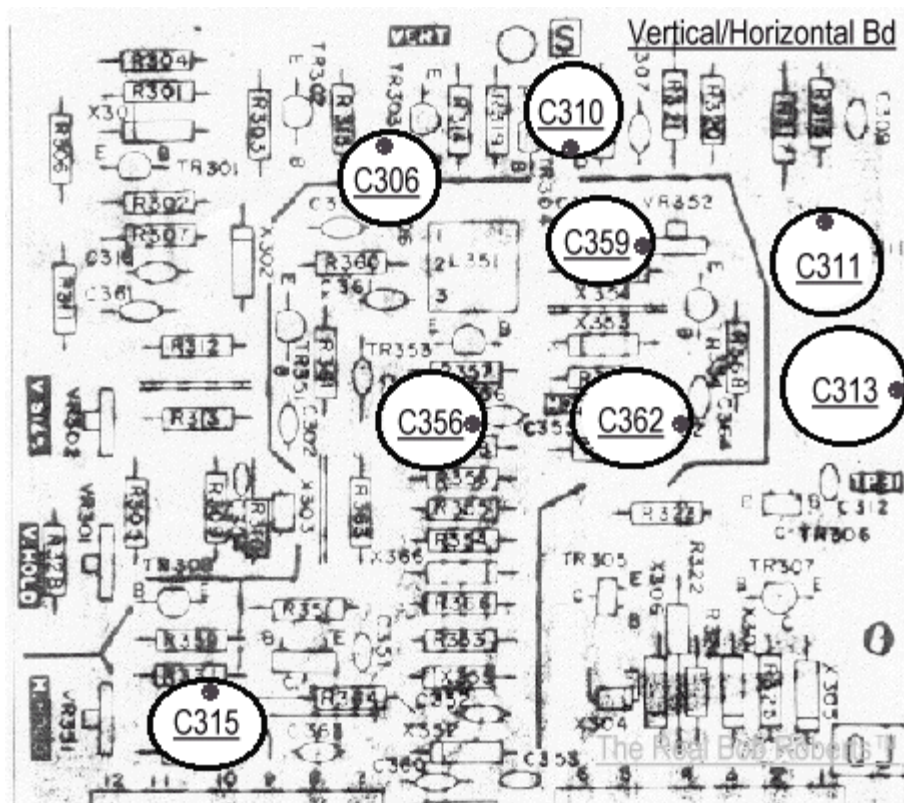
K4600 Series Cap Map

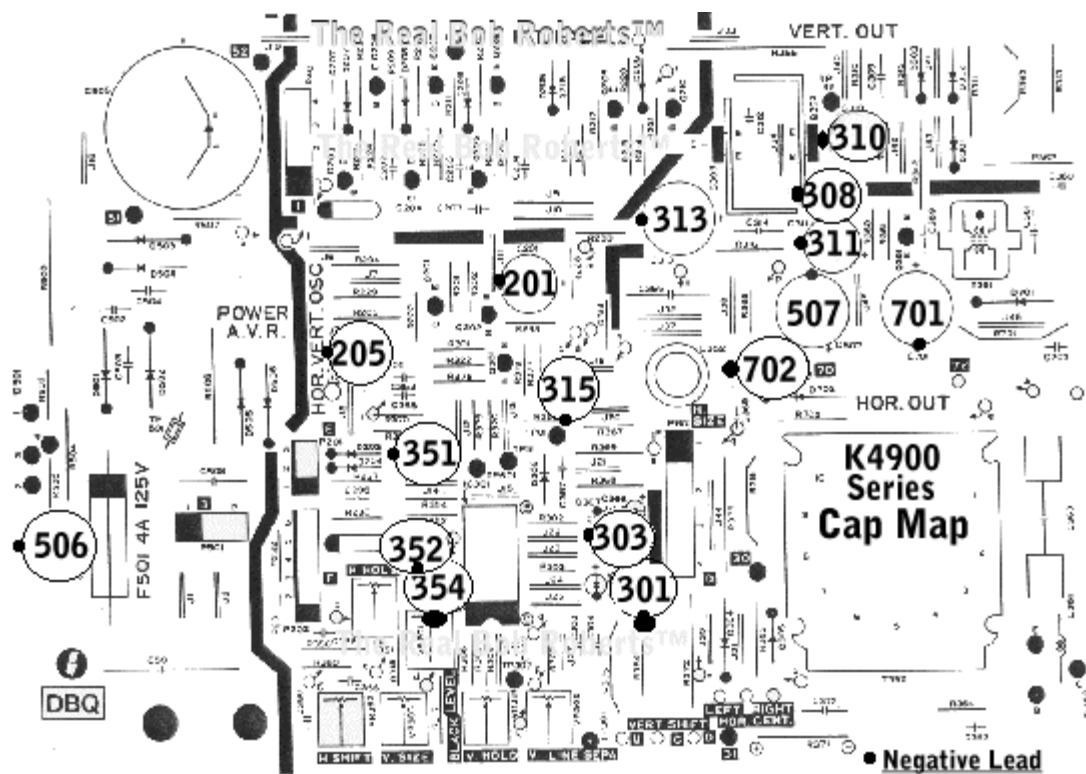


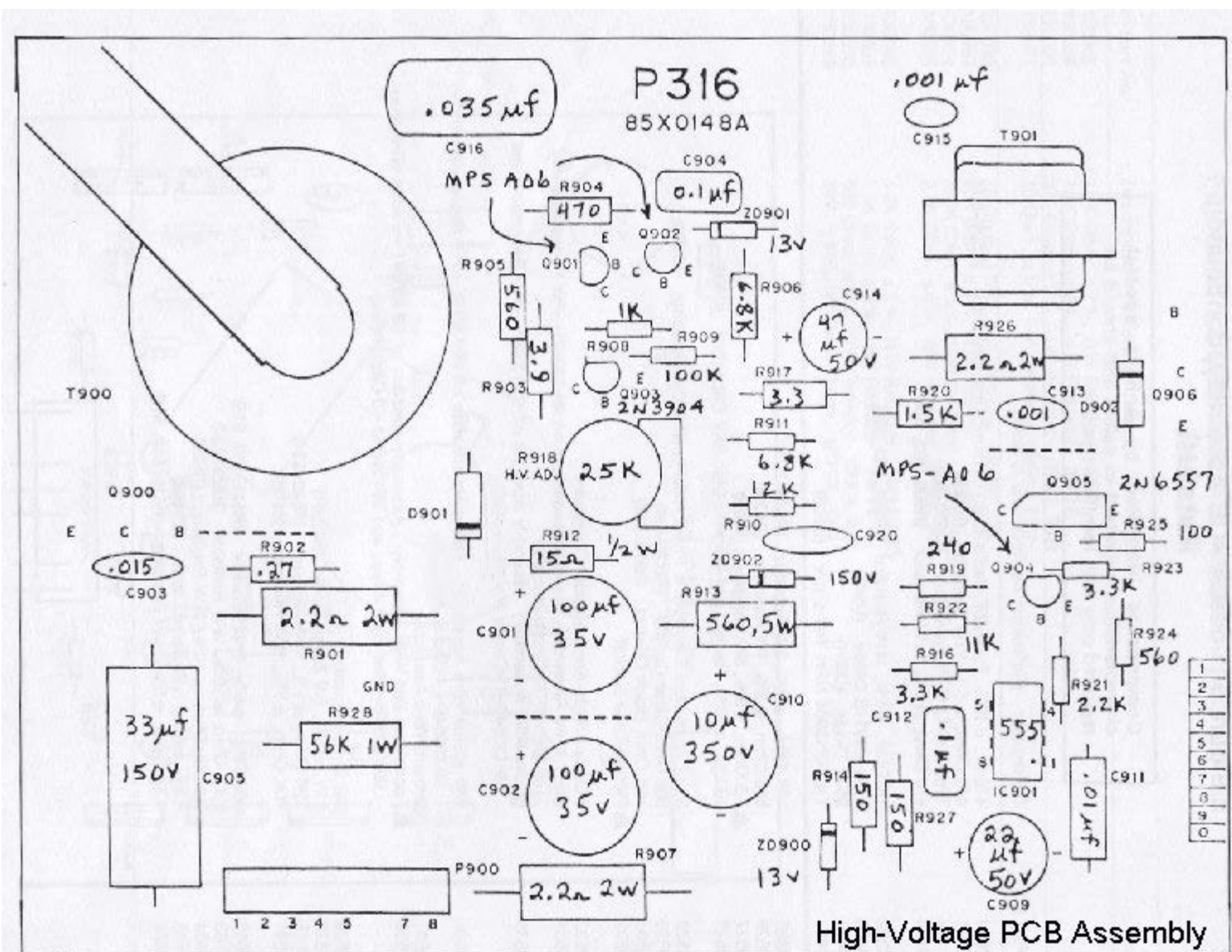
Some Interface Bds will have 1 cap or no cap & others will have the black level pot in a different location &/or a horiz center pot.



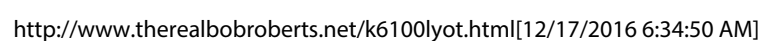
There are many variations of this board & if you have the caps above you should carefully observe polarity of the old ones. Some will be 180 degrees from others with the same P number

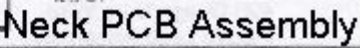


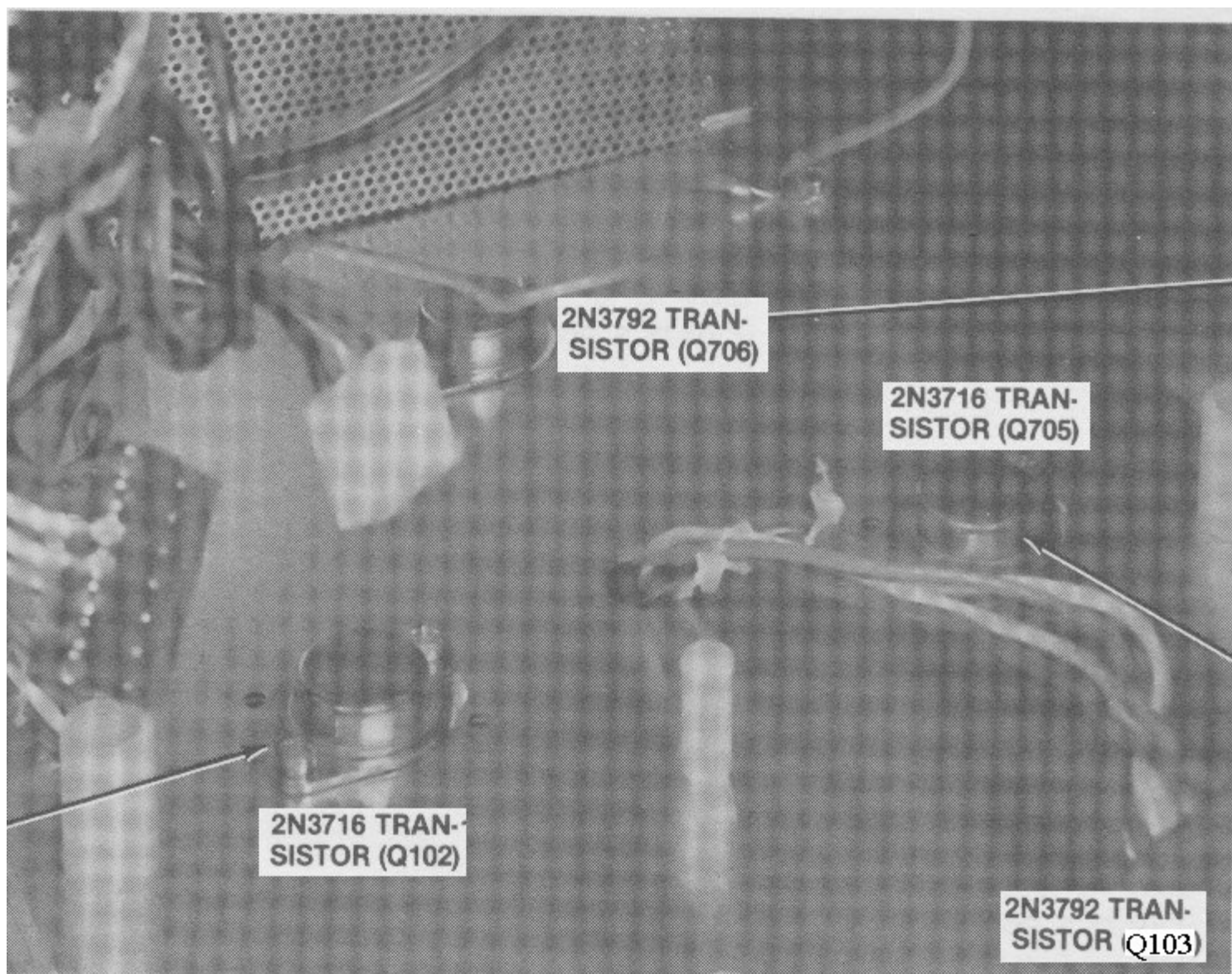


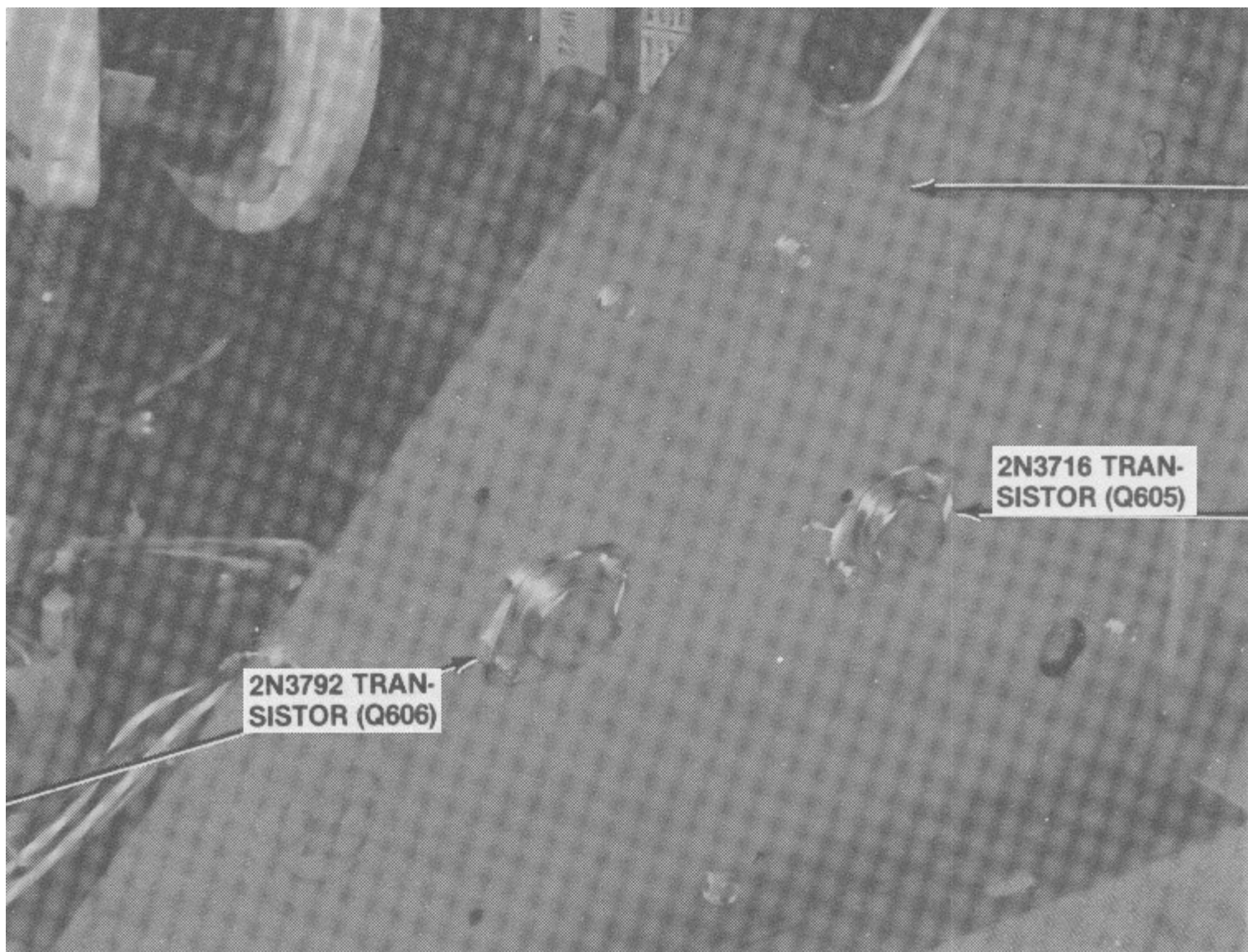


High-Voltage PCB Assembly









Do Not Hook Up Your

**Composite Sync
To Both H & V
On This Chassis**

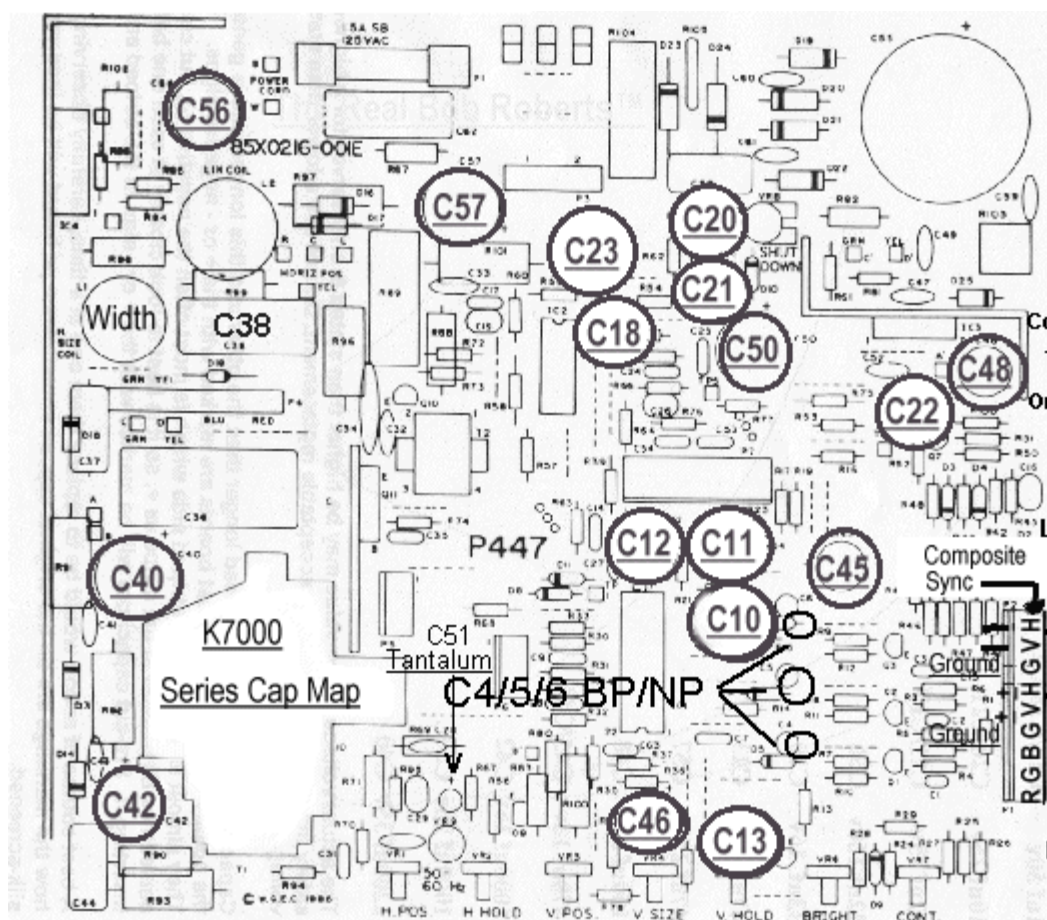
Use H Only!!

Leave V Empty

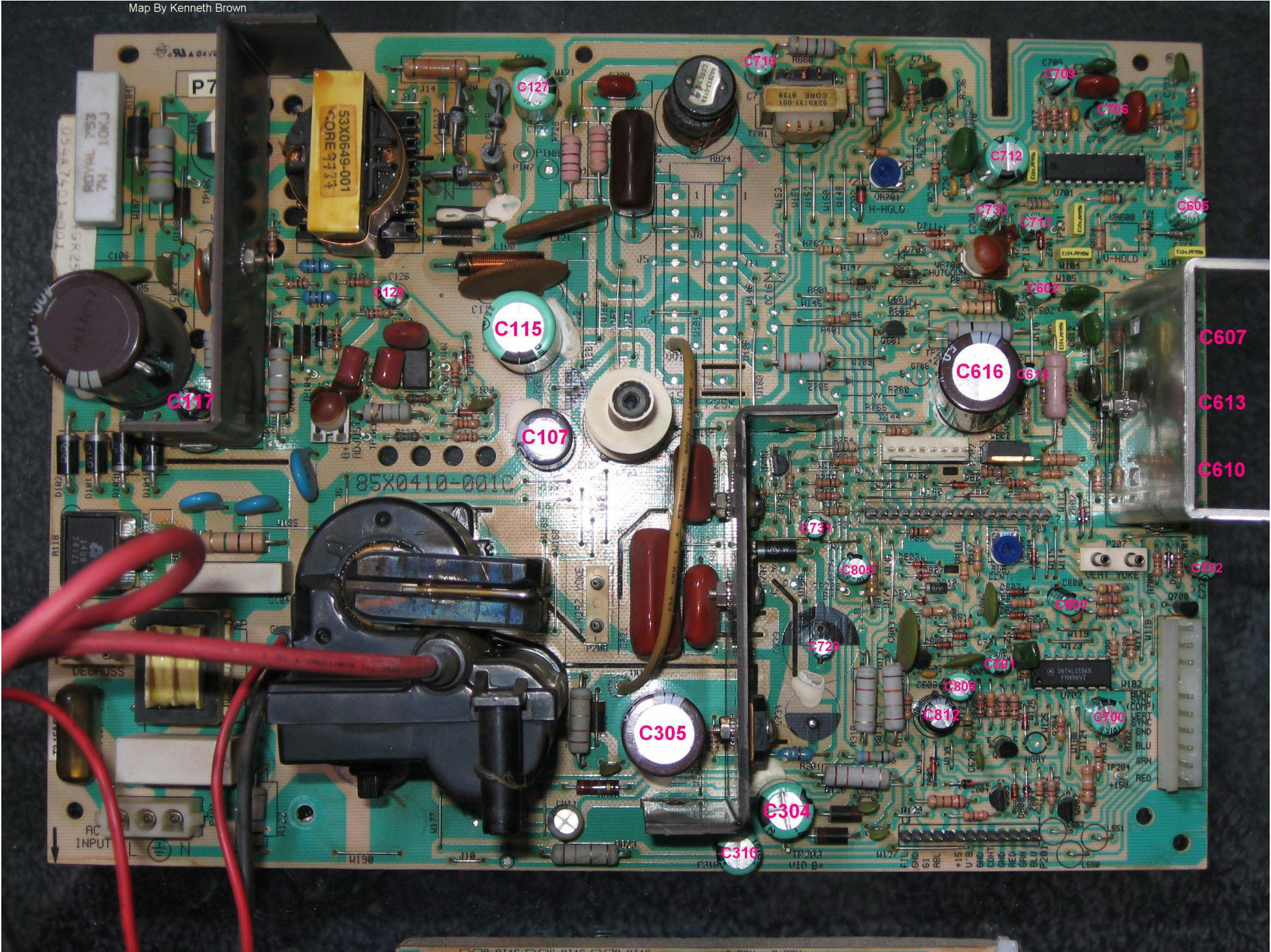
— Neg Comp
Sync

— Pos Comp
Sync

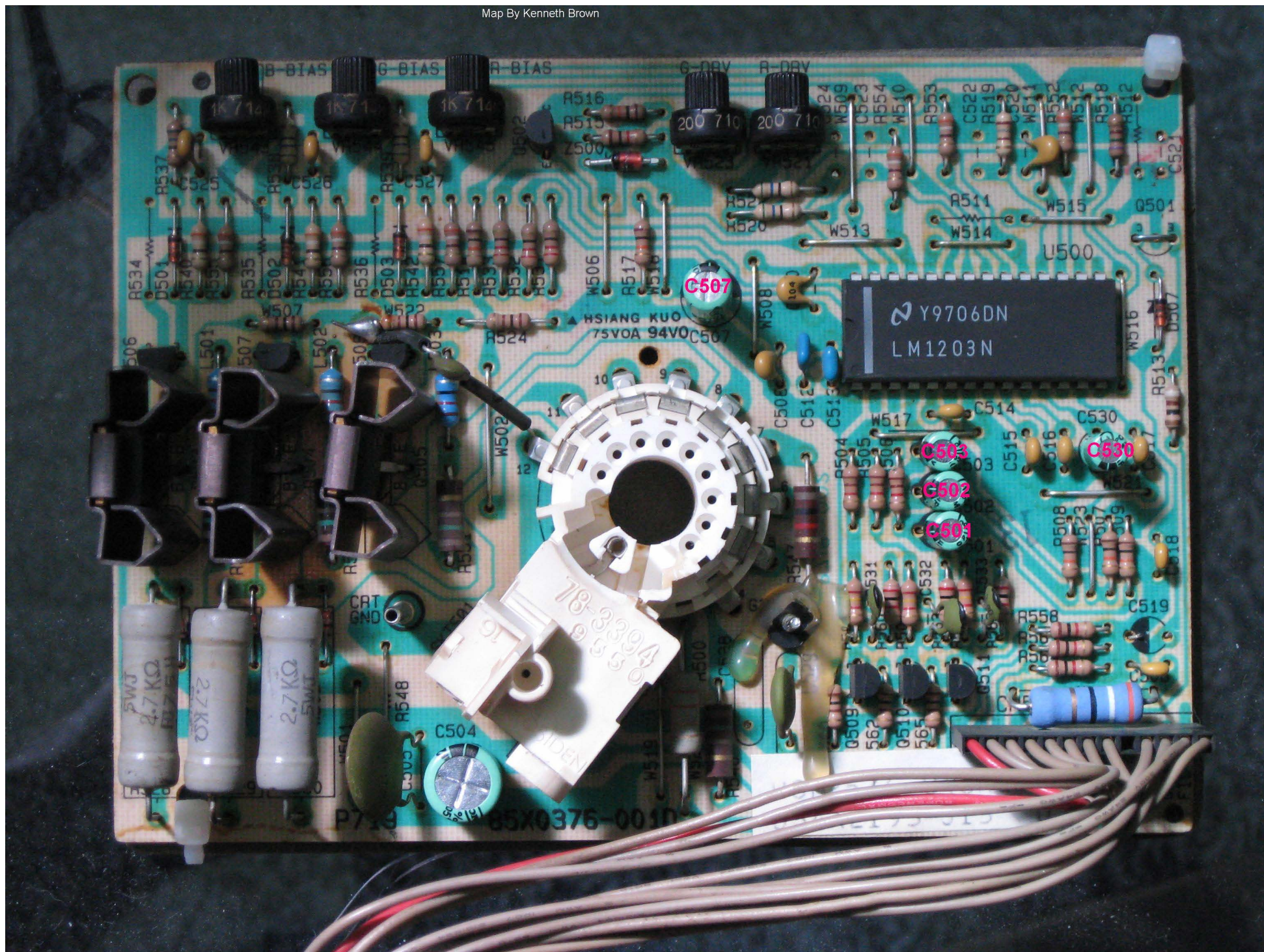
**C38 Value
Determines
Overall
Width**

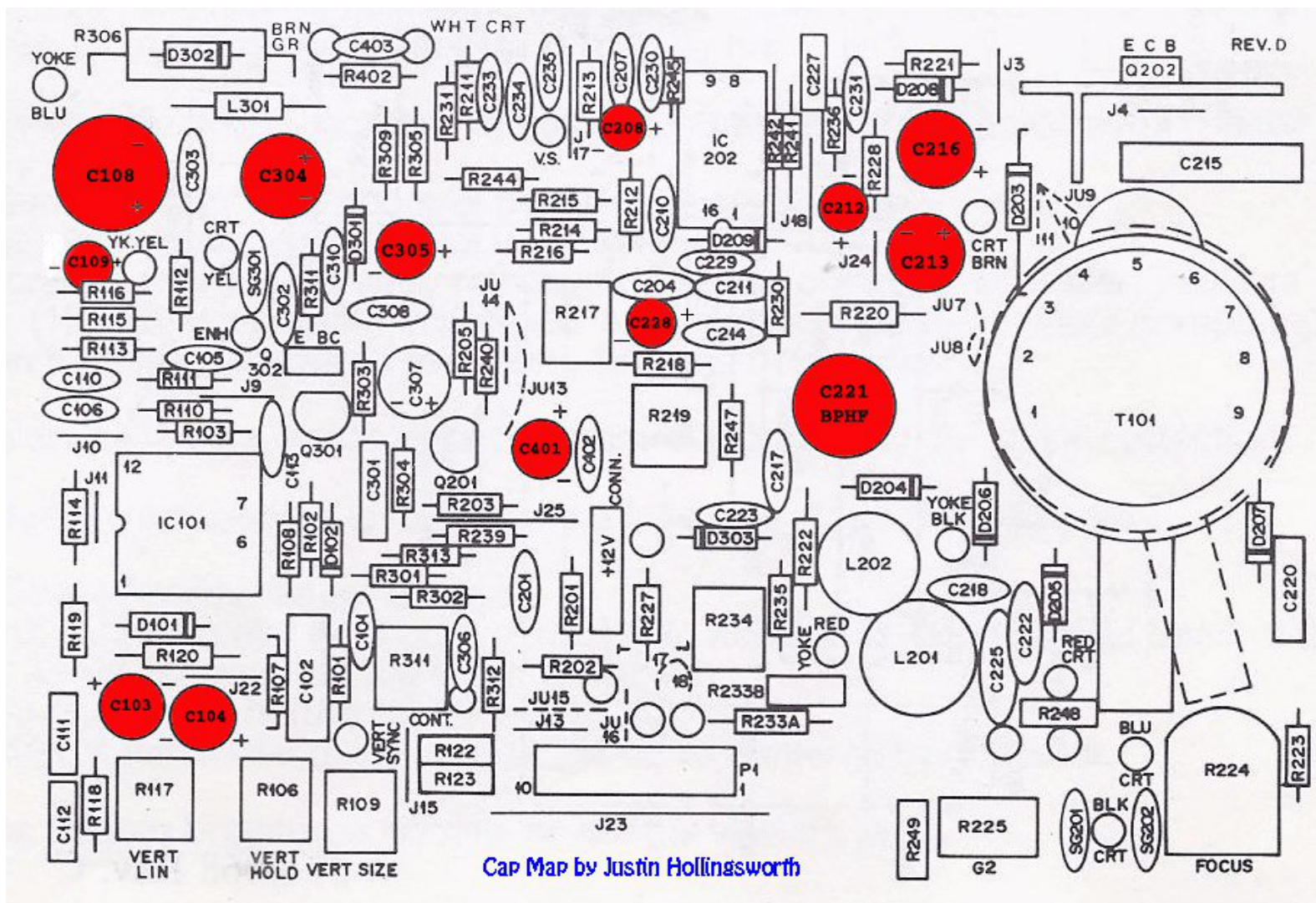


Map By Kenneth Brown

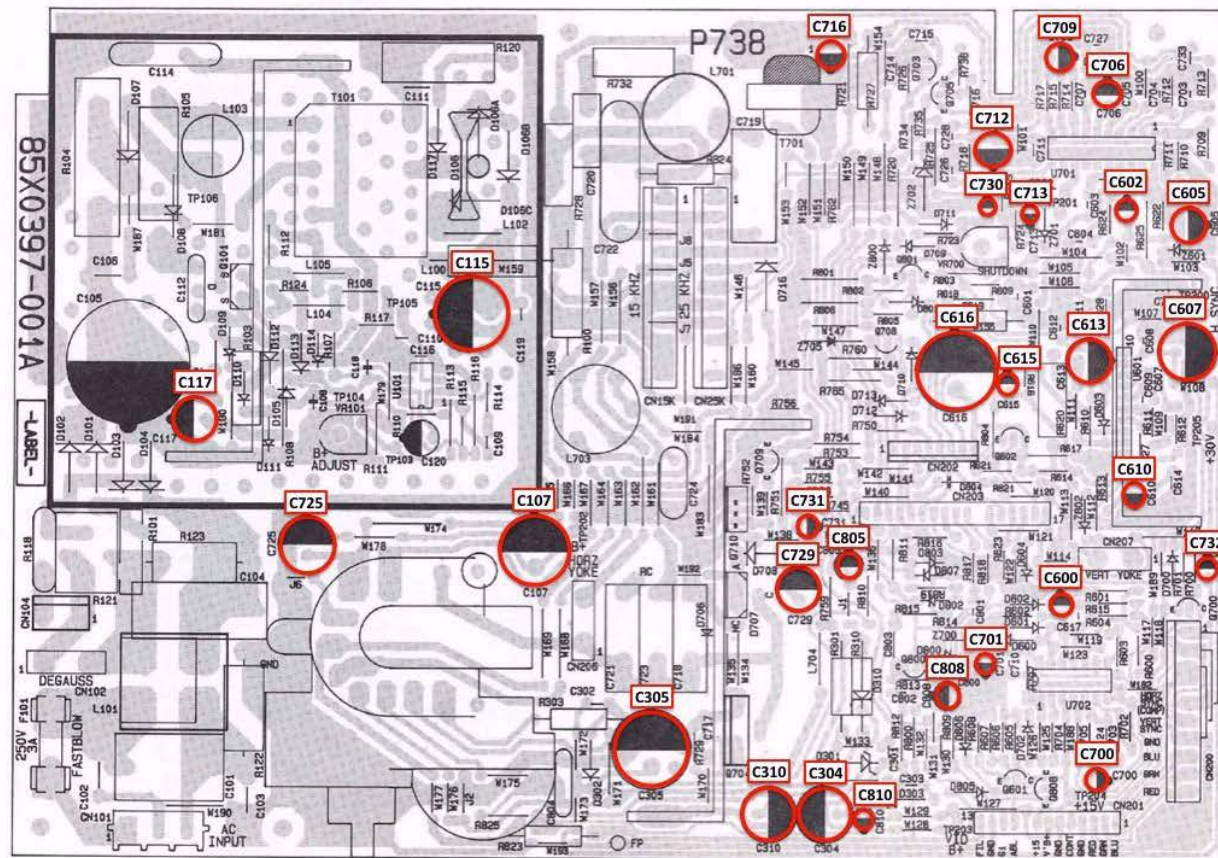


Map By Kenneth Brown





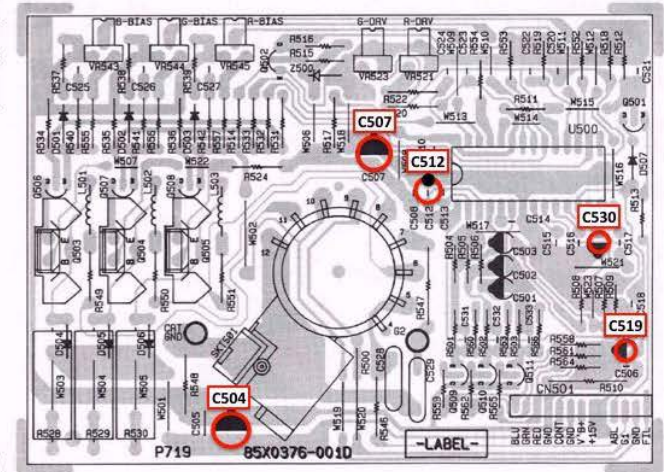
U5000 Cap Map



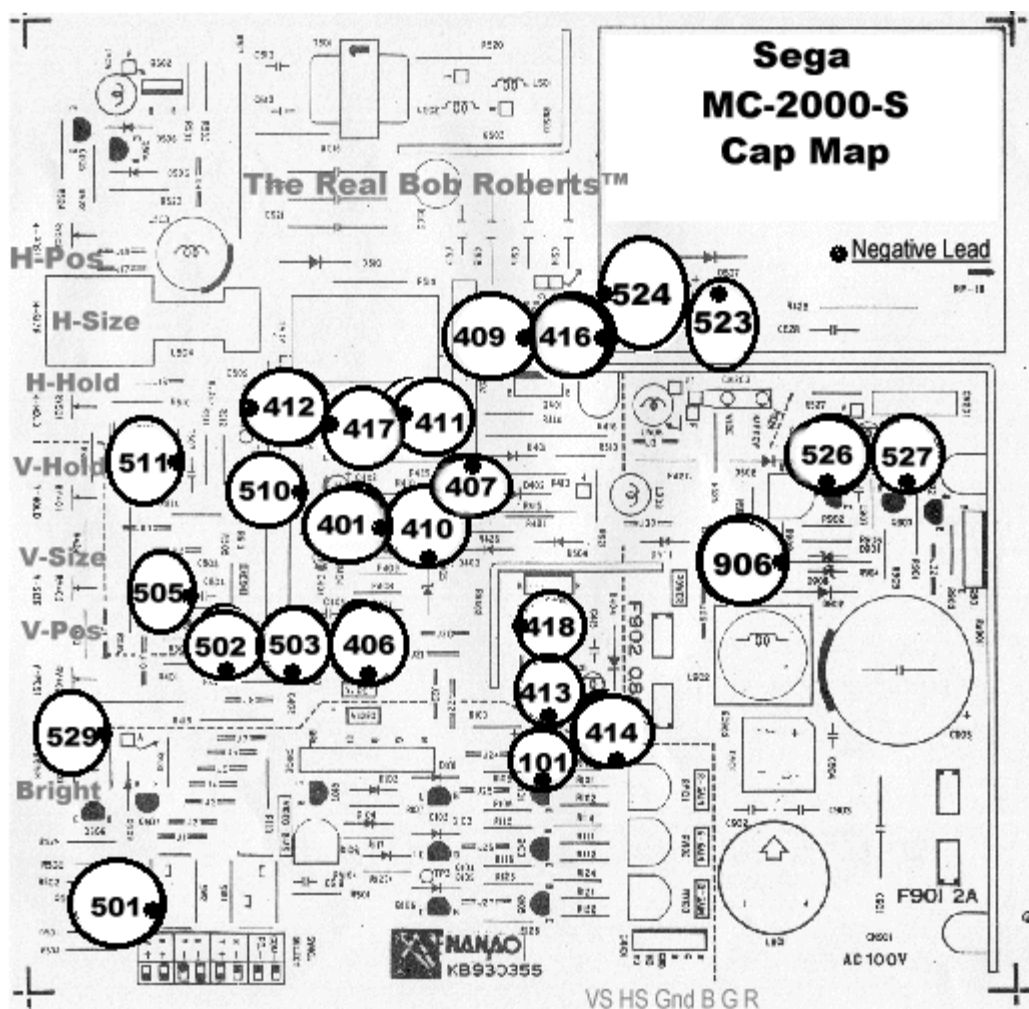
Wells-Gardner U5000 Service Manual

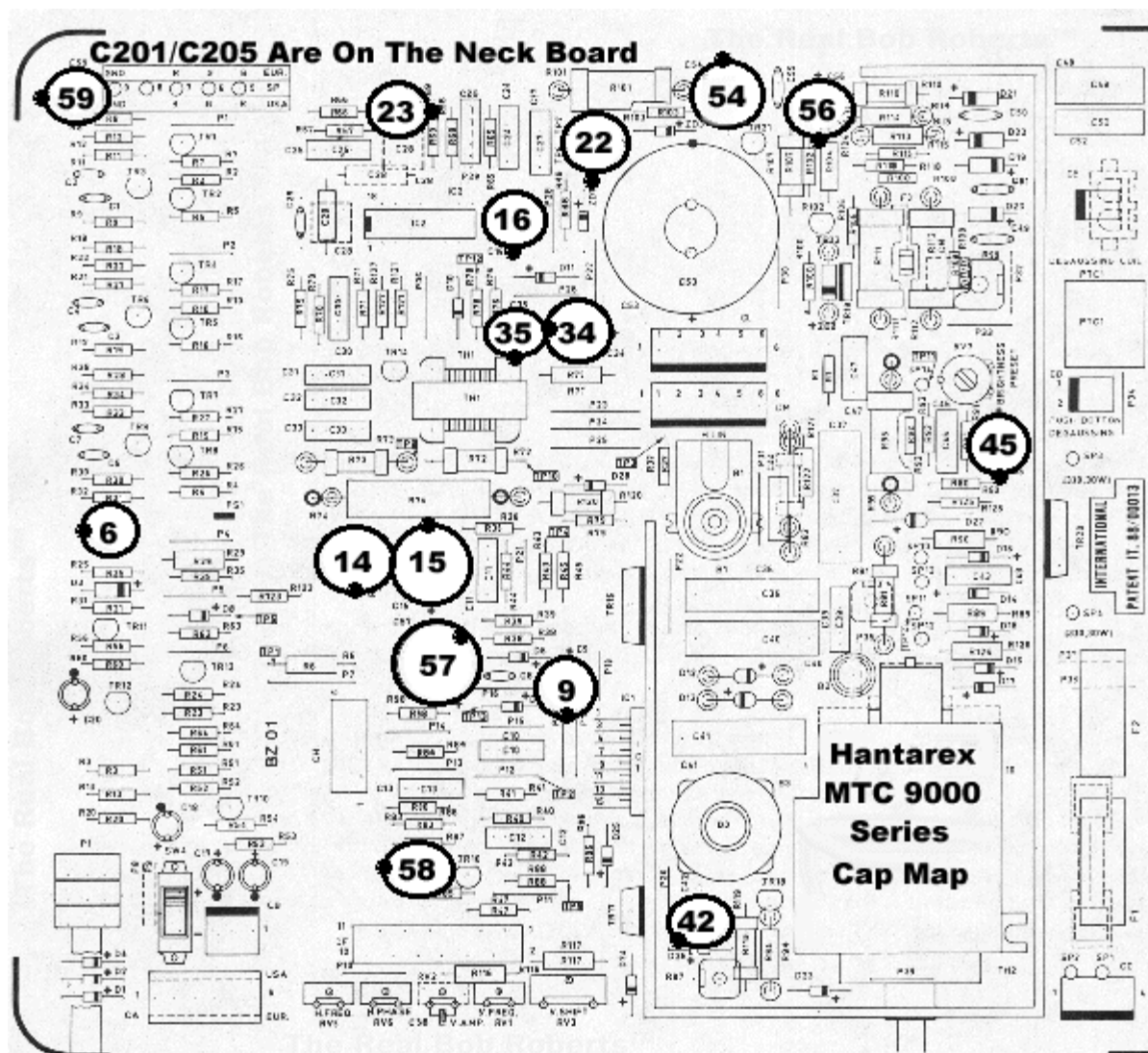
Printed Circuit Board Layouts

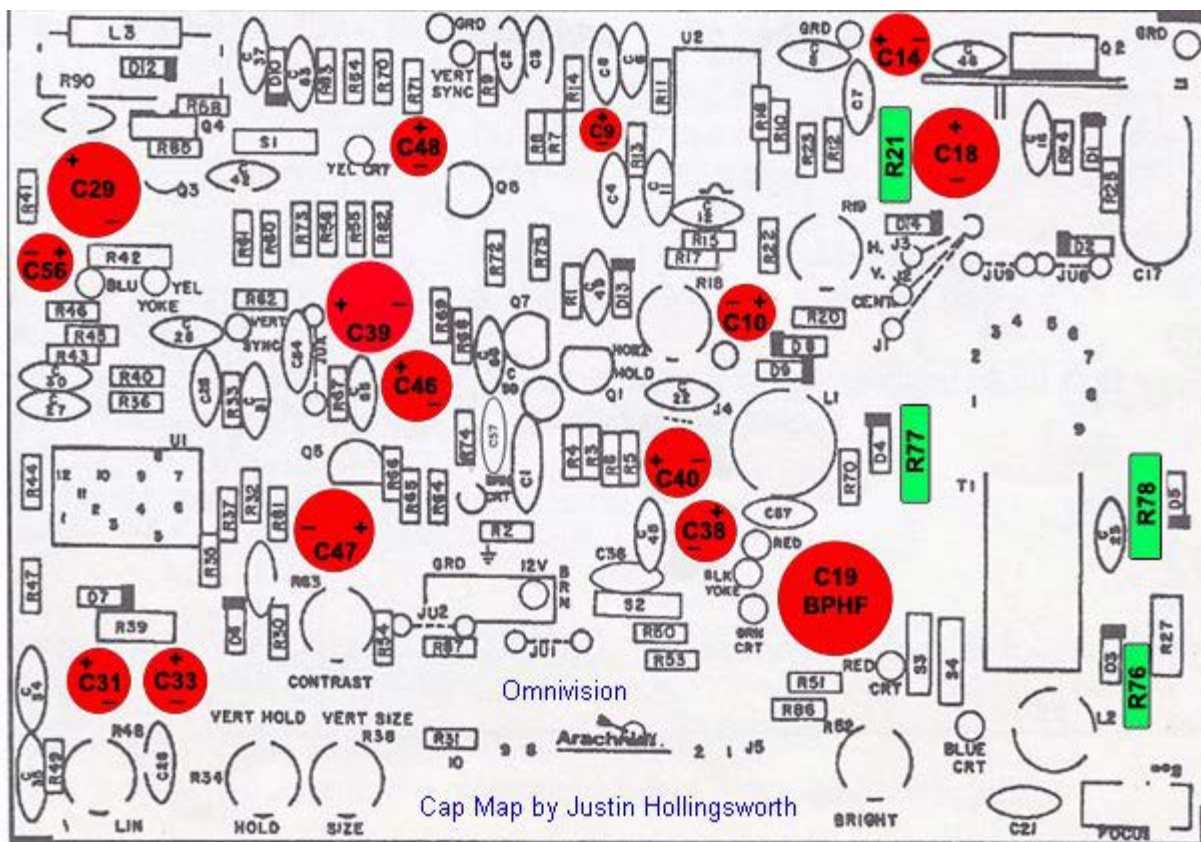
P719 Neckboard

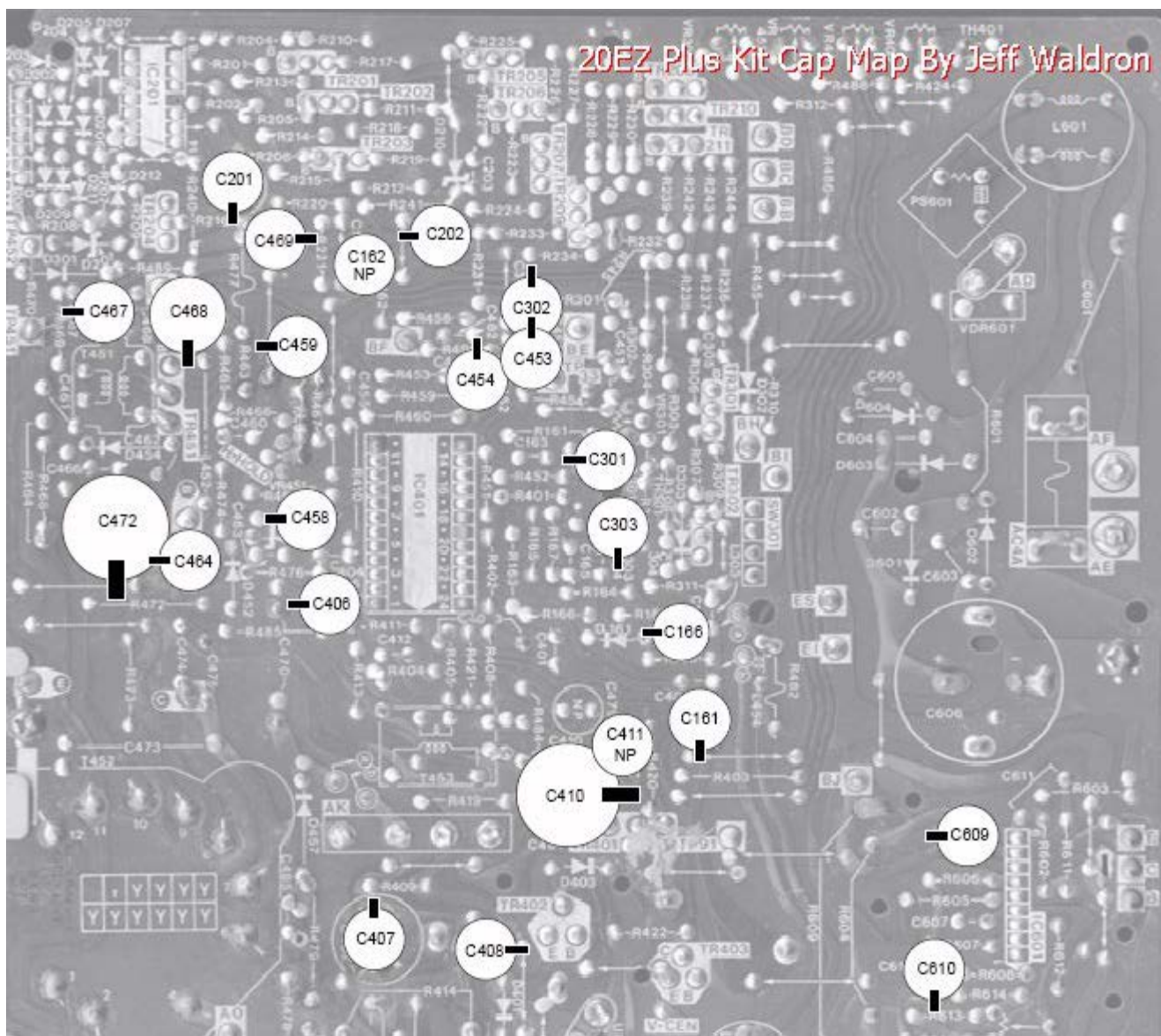


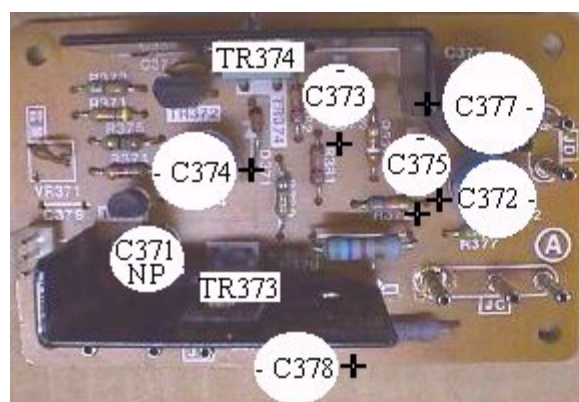
Compliments of Marc Crouse





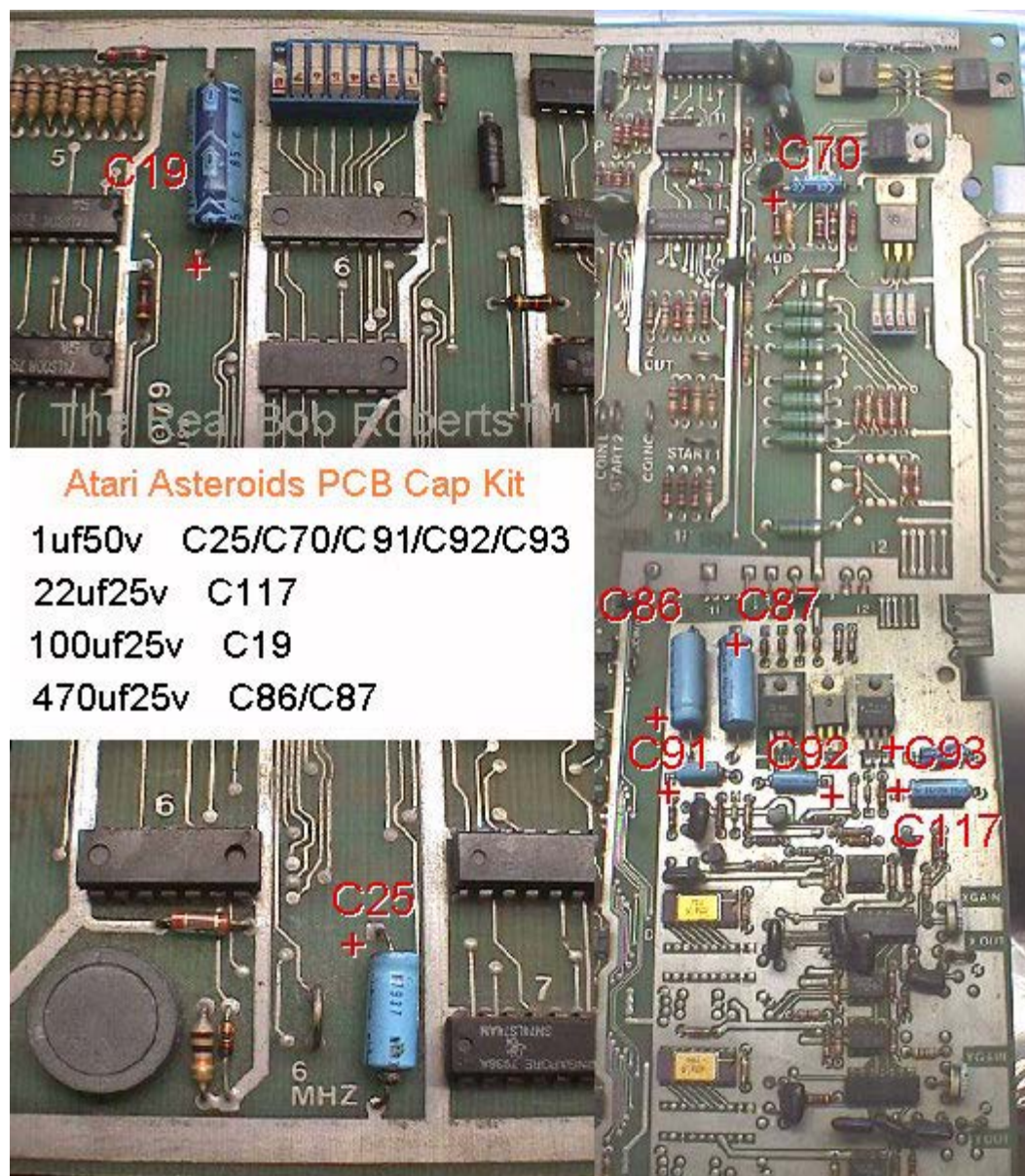


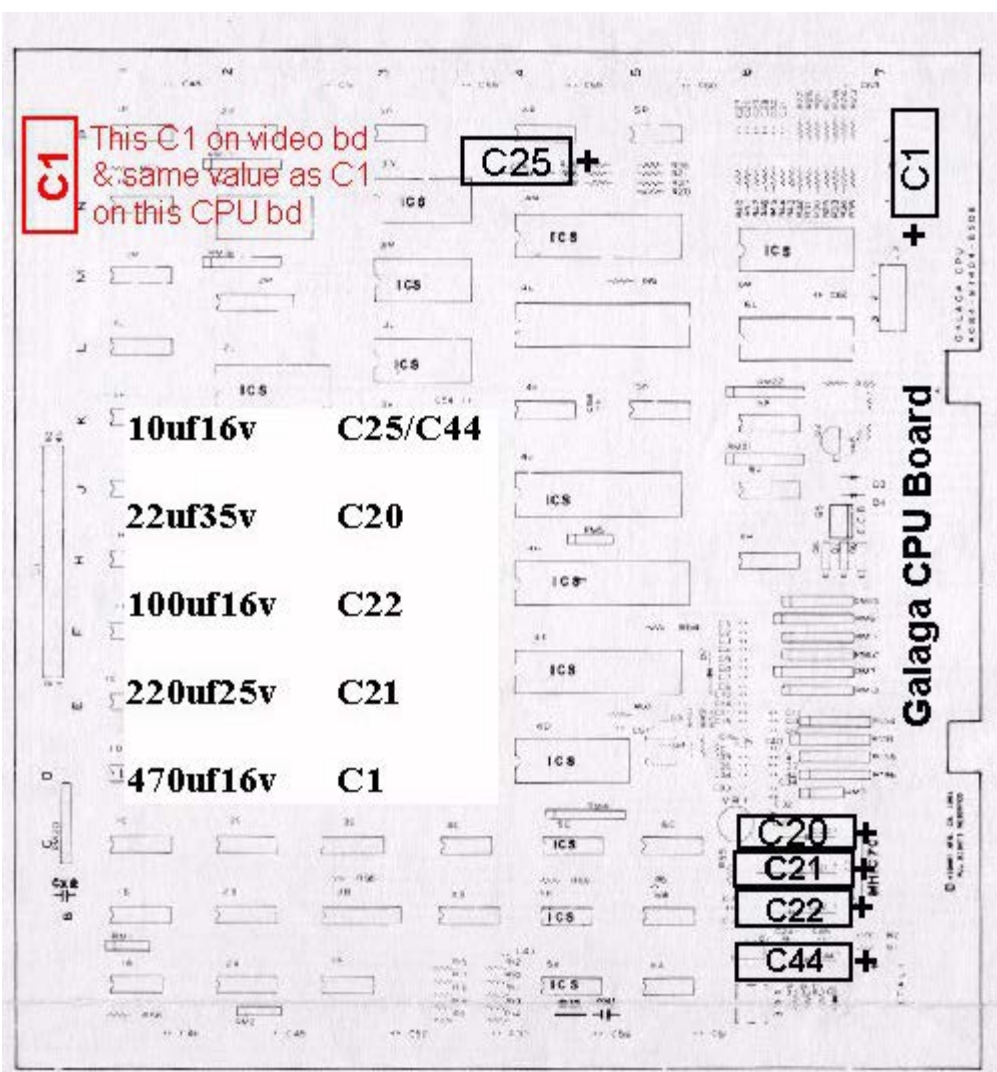


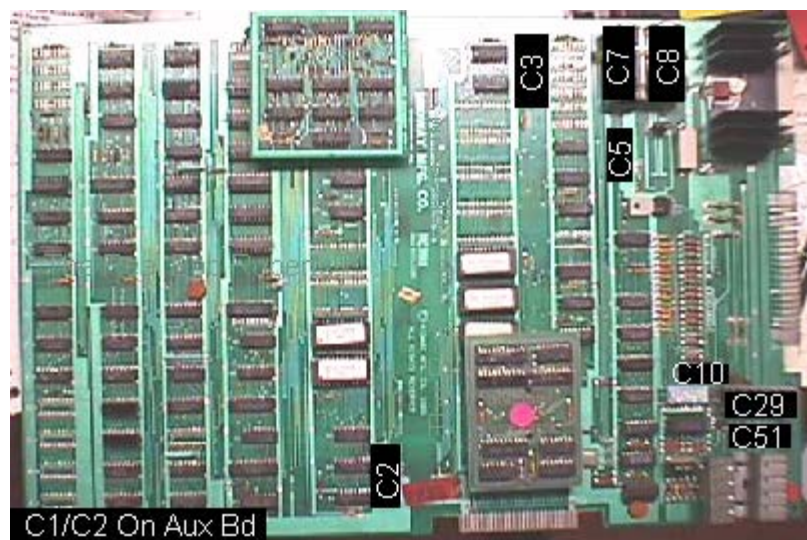


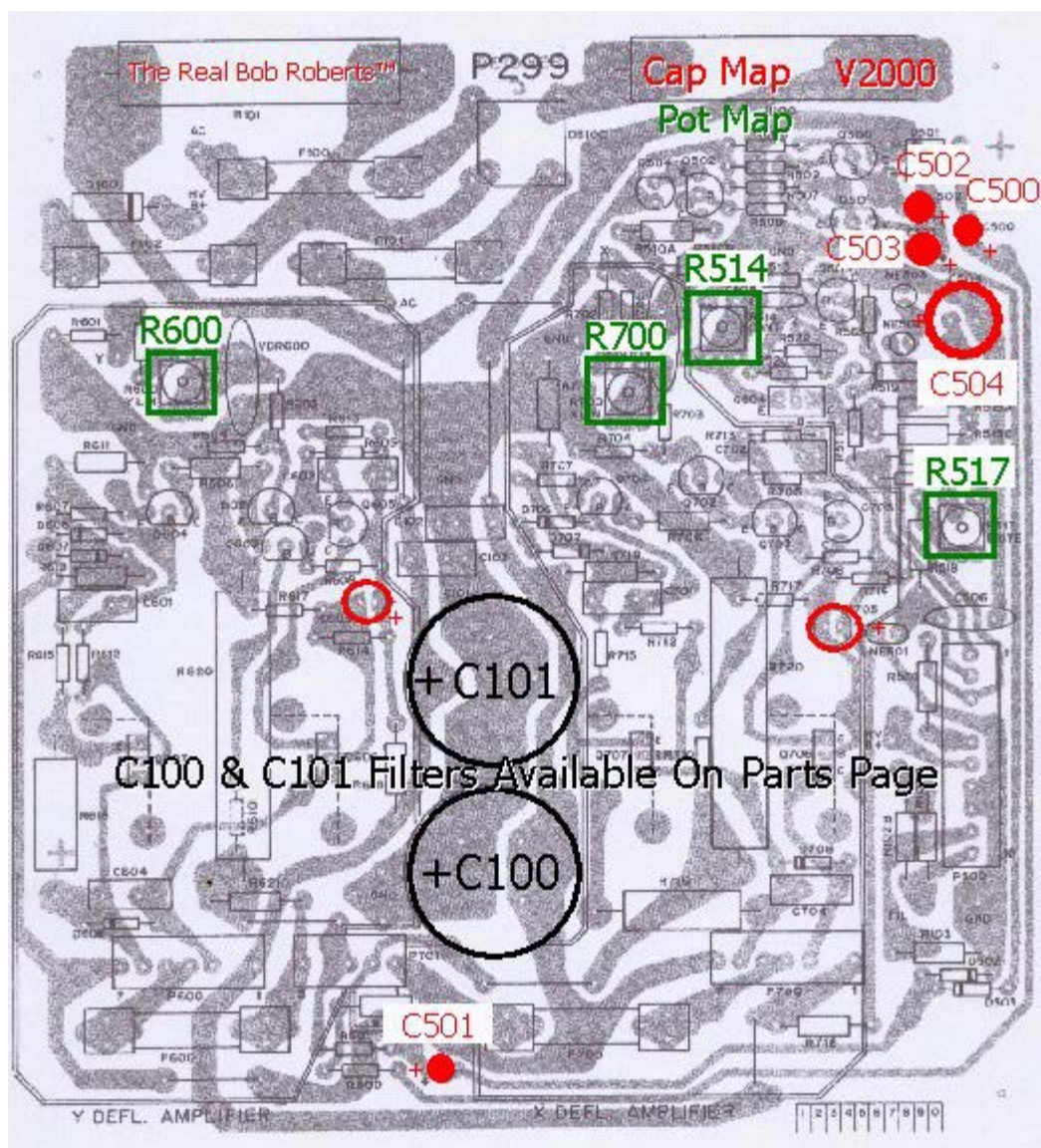
4.7uf 25v NP	C371
4.7uf 160v	C372/C374
10uf 50v	C375
10uf 160v	C378
22uf 160v	C377
100uf 25v	C373
2SA940	TR374
2SC2073	TR373

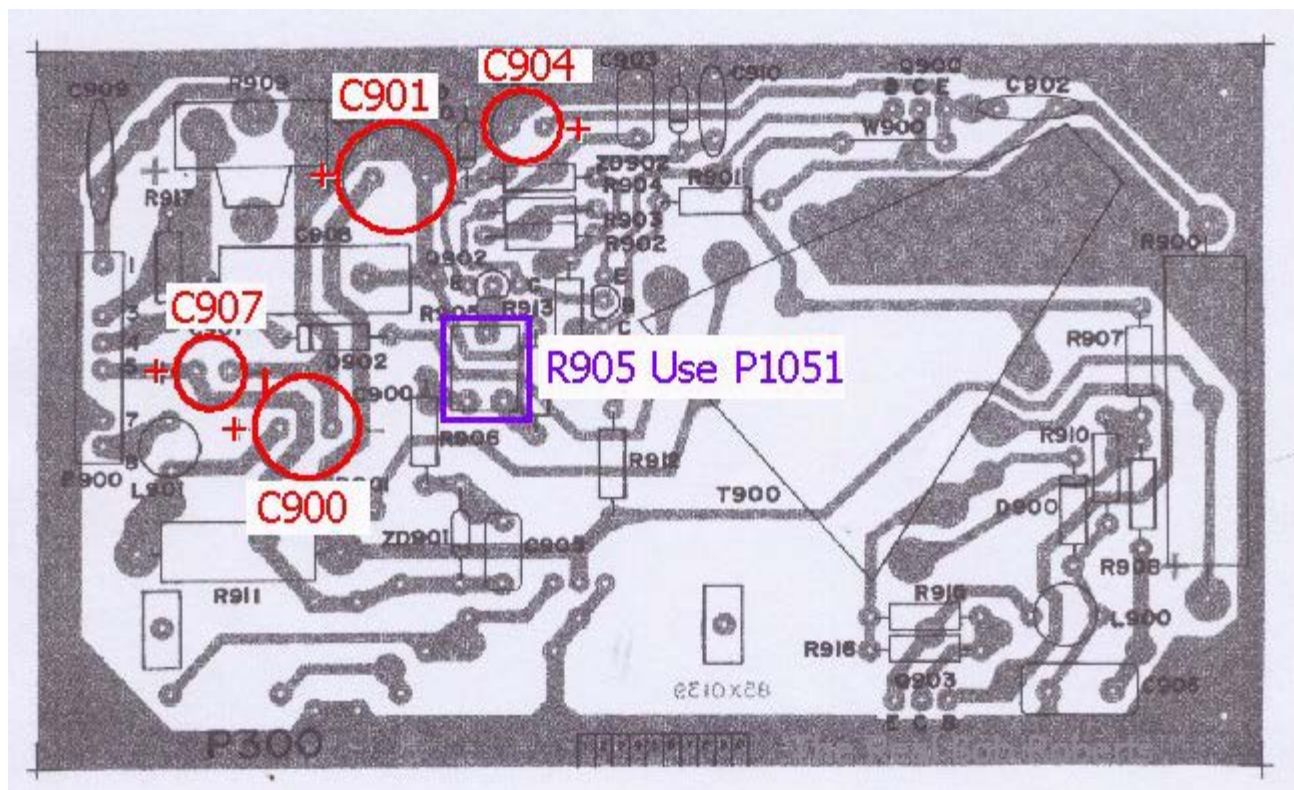
The Real Bob Roberts™



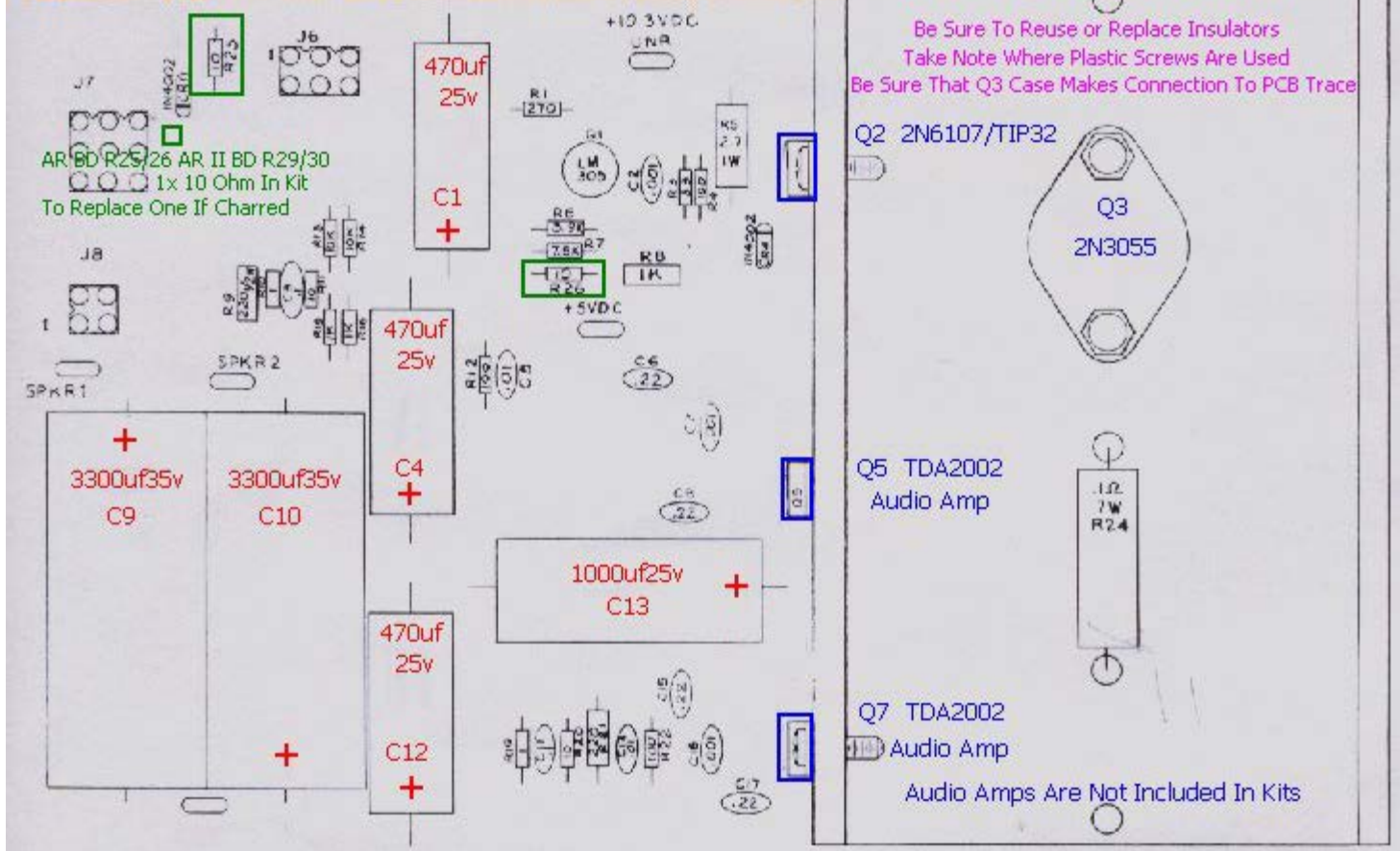


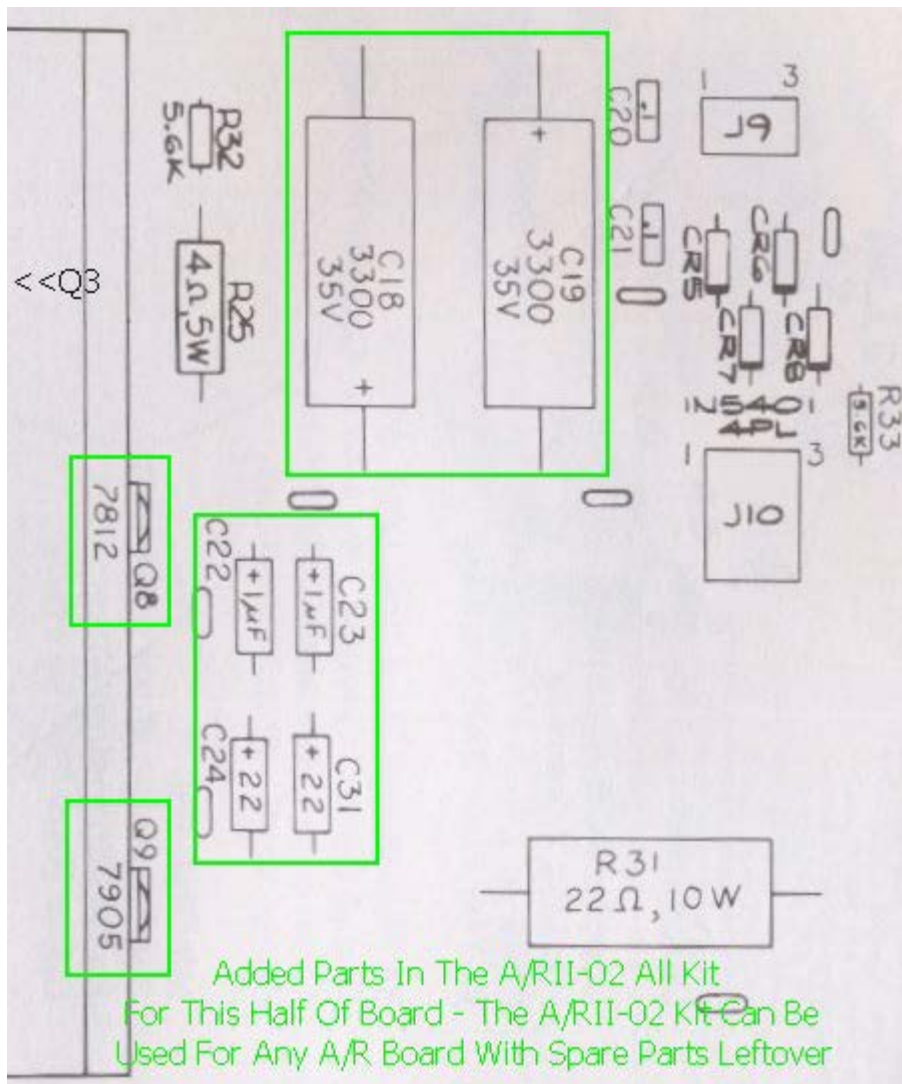


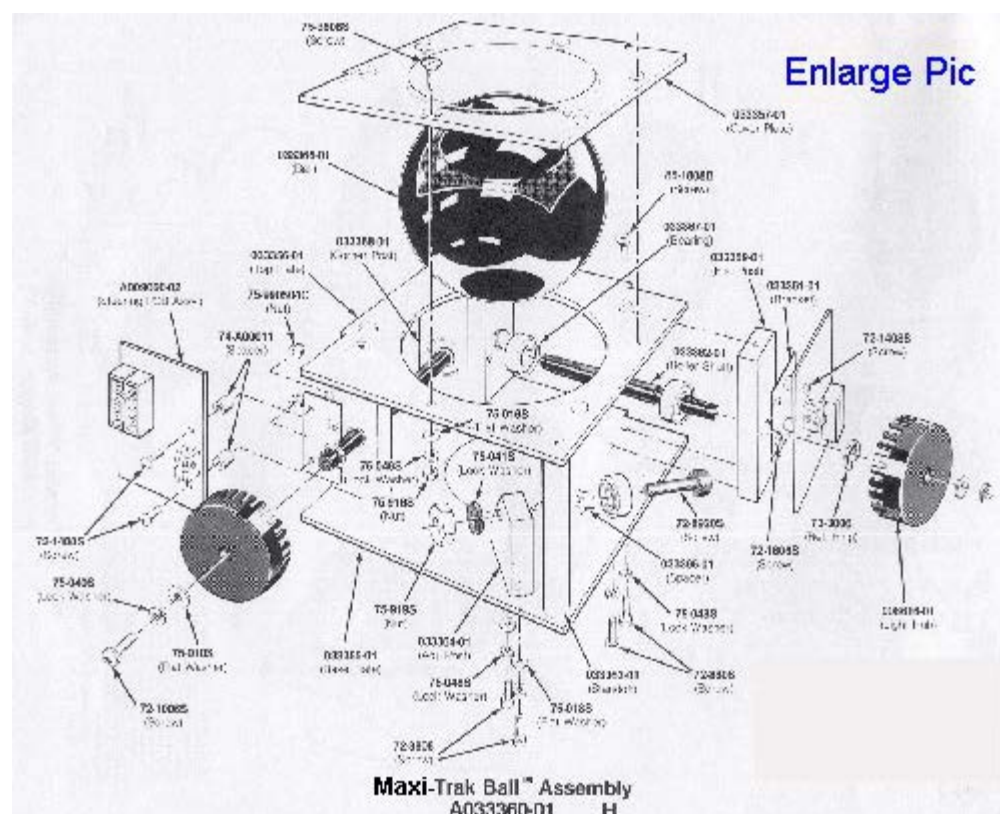
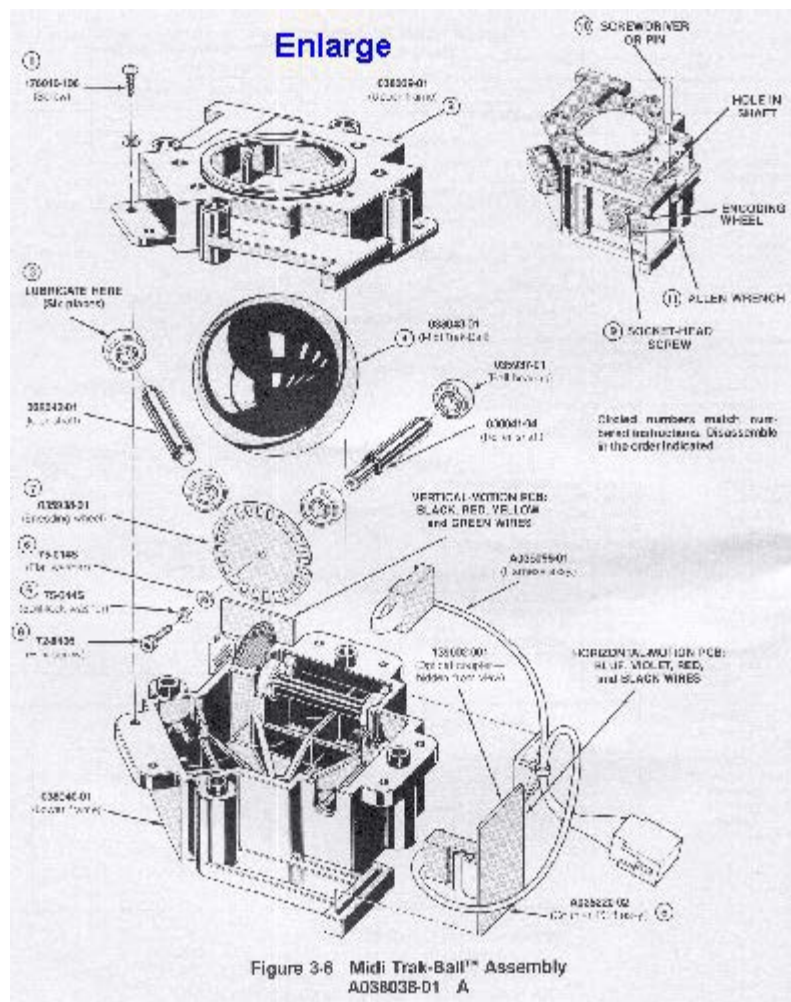


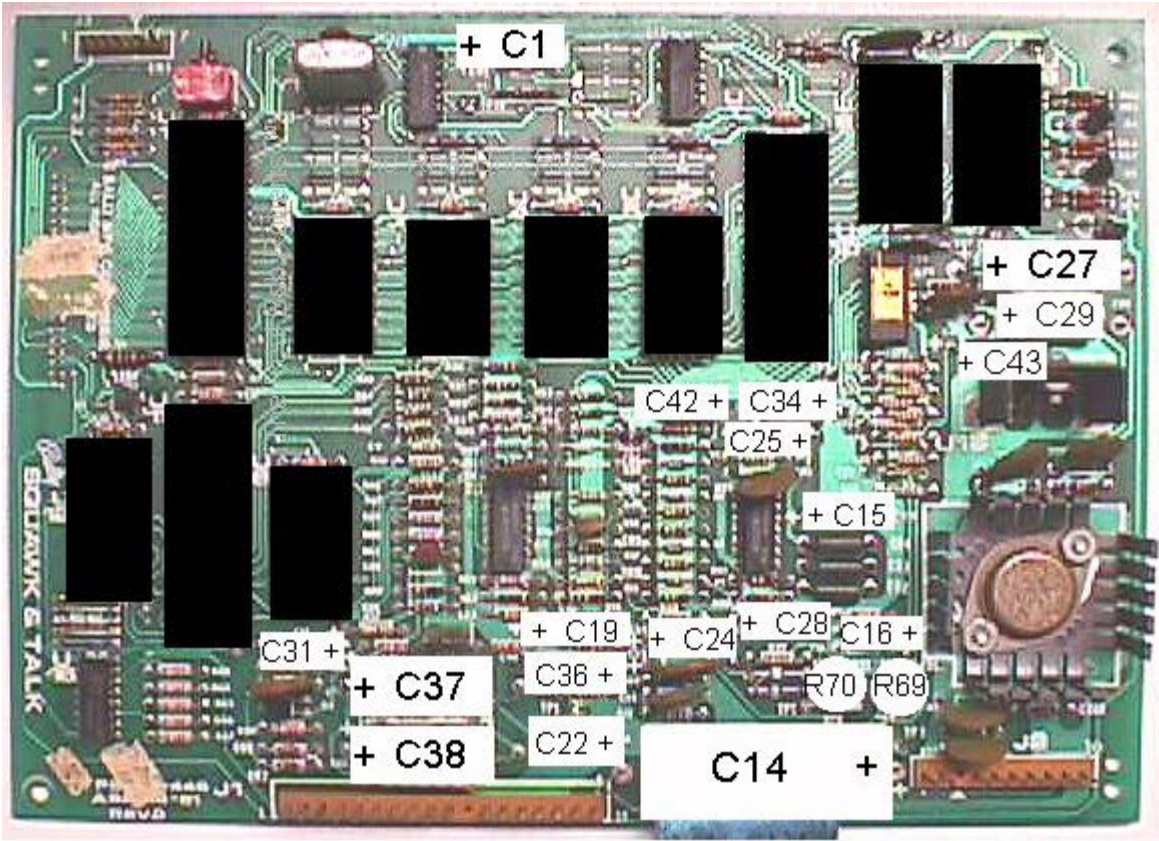


A/R Board -01/-02/-03 Half Board of A/R II-all Subtle Differences From Board To Board
But Does Not Pertain To Kit Which Covers All Versions With Some Parts Leftover On Some









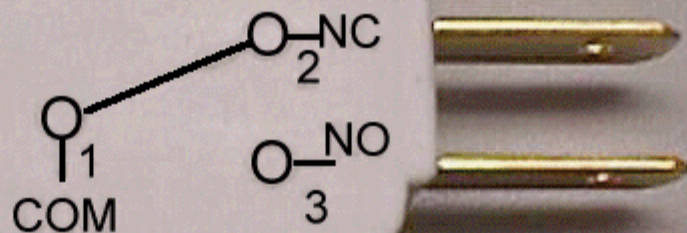
C1	47uf16v	C22	4.7uf25v	C29	470uf10v	C38	330uf50v
C14	4700uf25v	C24	1uf50v	C31	1uf50v	C42	1uf50v
C15	10uf25v	C25	1uf50v	C34	1uf50v	C43	2.2uf25v
C16	4.7uf25v	C27	1000uf16v	C36	2.2uf25v	R69	1K Pot
C19	1uf50v	C28	1uf50v	C37	330uf50v	R70	1K Pot

The Real Bob Roberts™

1 Com for common ground from PCB

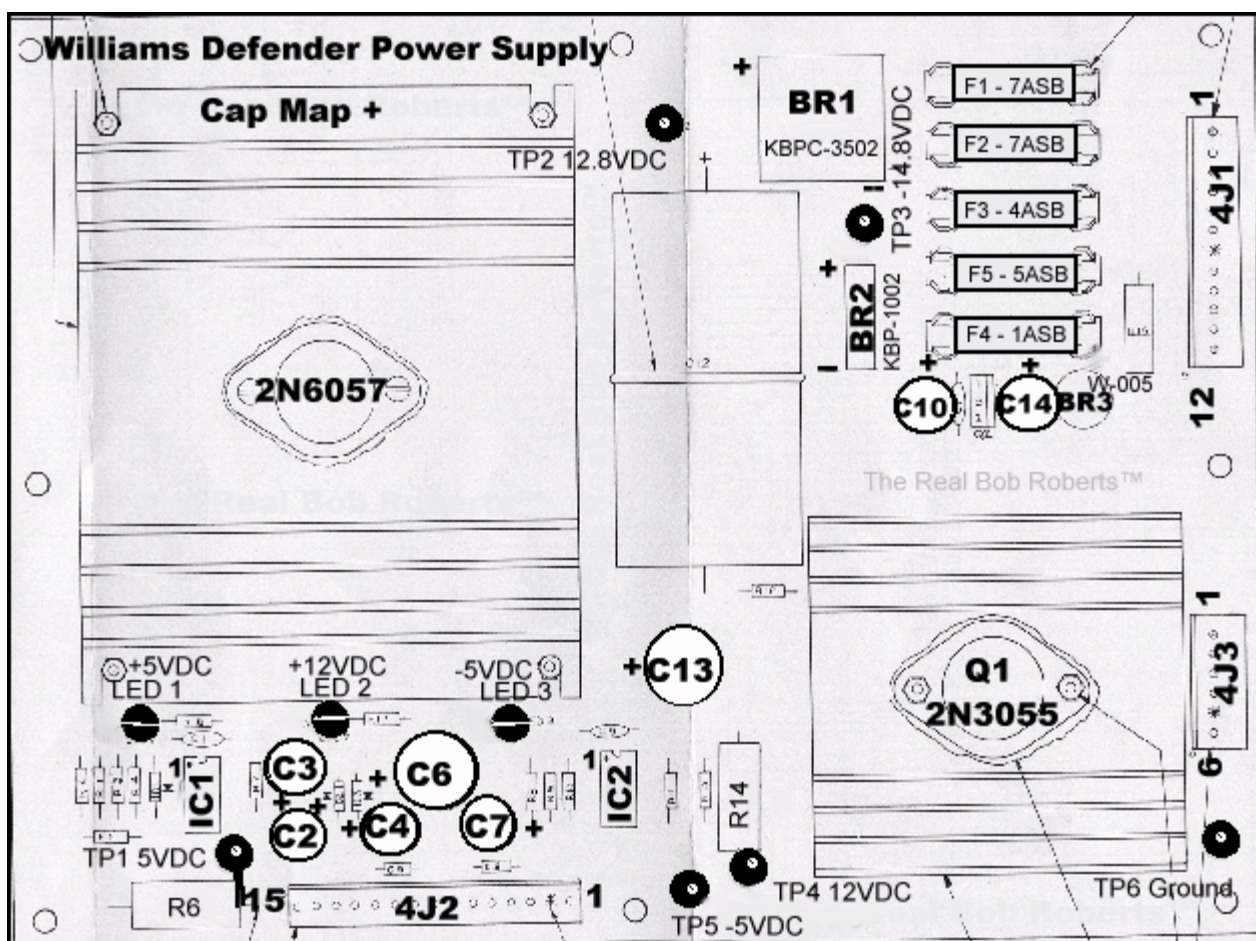
2 NC for normally closed - no connection - open on push

3 NO for normally open - grounds when pushed



CP Ground Wiring

When adding in a ground line you can use 2 NC terminals that cannot be opened at the same time, i.e., joystick left & right, or up & down, since neither can ever be opened at the same time to break your ground circuit. Ground will always be present from one end of the loop or the other.



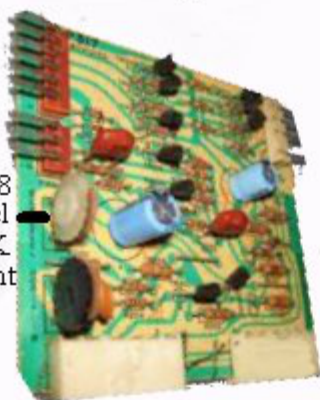


Thanks to Rich Cavallaro we can now say that the 1/8 security hex bit in the 100pc Security Set is the one needed for Gorf joystick handles.

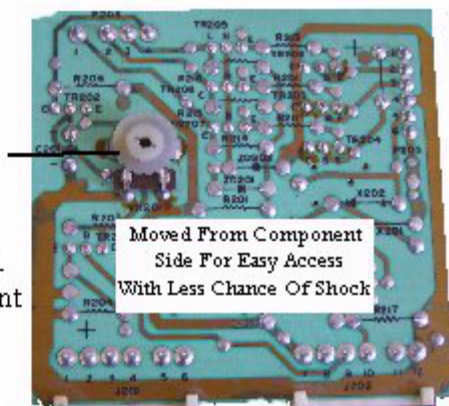


Two Types Of K4600 Interface Boards

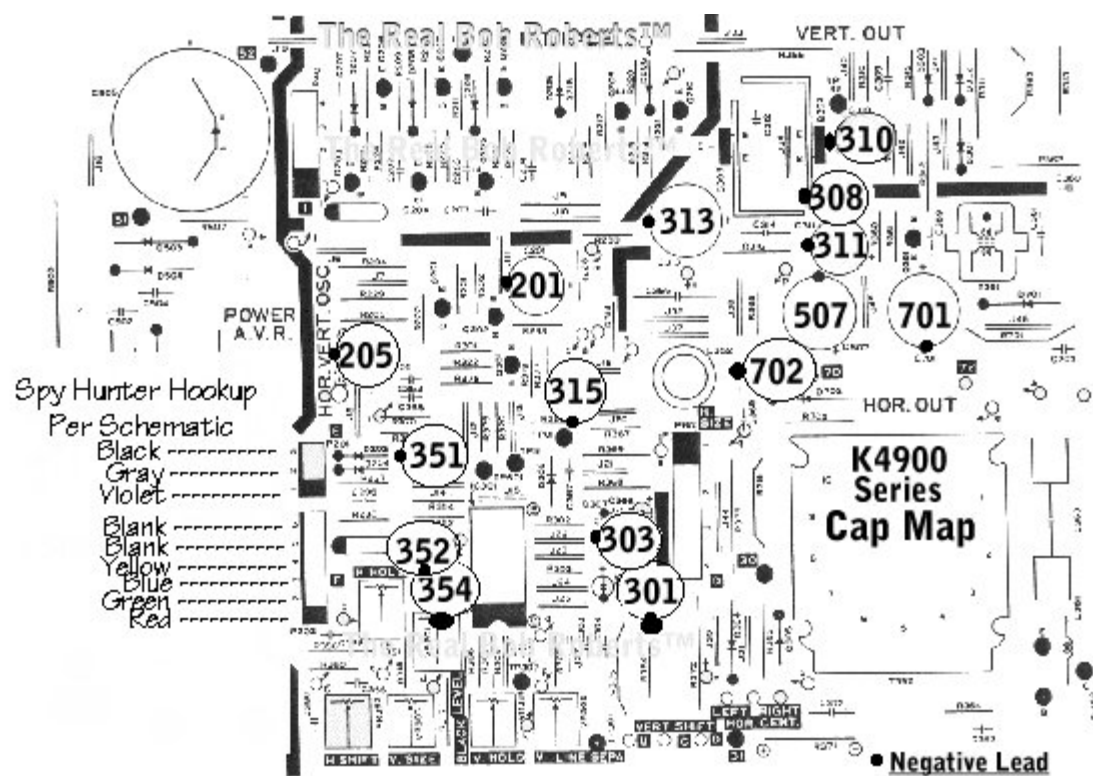
Type B
USE
P1016/17/18
Black Level
1.5K to 2.5K
Vertical Mount



Type A
USE
P1004
Black Level
1.5K to 2.5K
Horizontal Mount

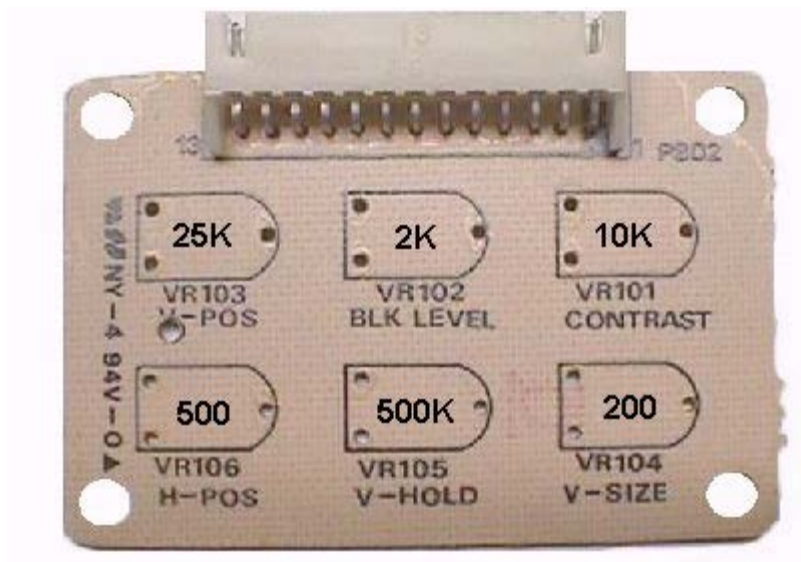


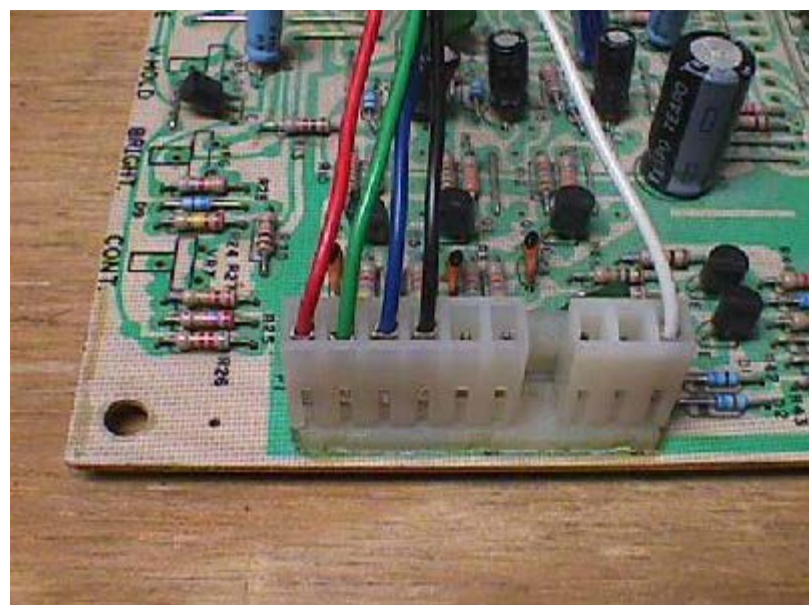




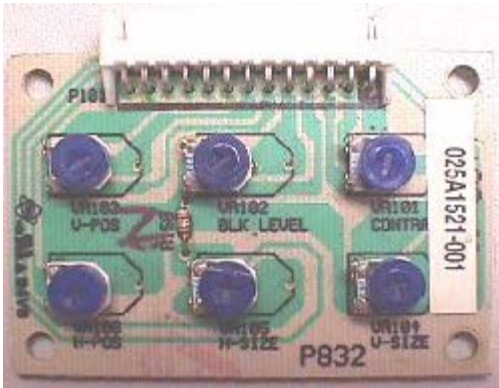
k7000foot.jpg %d×%d pixels







The K7200 P832 remote board uses 6 mini horizontal mount pots as pic'd below, however, the board layout also includes the option of using the standard WG horizontal pots.

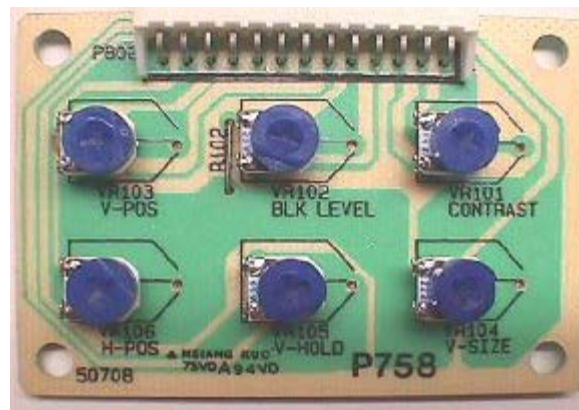


V101	10K Ohm Trim Pot	Contrast
V102	2K Ohm Trim Pot	Black Level
V103	30K Ohm Trim Pot	Vertical Position
V104	200K Ohm Trim Pot	Vertical Size
V105	5K Ohm Trim Pot	Horizontal Size
V106	10K Ohm Trim Pot	Horizontal Position

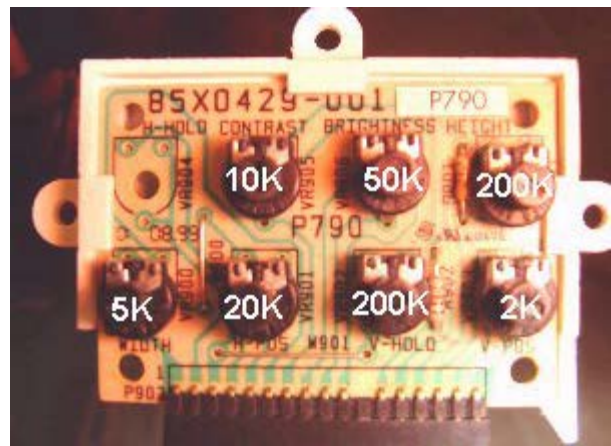
These horizontal mount mini pots are used in other apps, as well, so I have stocked various values for sale & will list them below. Hopefully, this will save you from having to hunt one down or hacking something in place of it.

Values Available		
P1089	100 Ohm Mini Horiz Mount Trim Pot	\$1.00
P1090	200 Ohm Mini Horiz Mount Trim Pot	\$1.00
P1091	500 Ohm Mini Horiz Mount Trim Pot	\$1.00
P1156	1 Kohm Mini Horiz Mount Trim Pot	\$1.00
P1092	2 Kohm Mini Horiz Mount Trim Pot	\$1.00
P1093	5 Kohm Mini Horiz Mount Trim Pot	\$1.00
P1094	10 Kohm Mini Horiz Mount Trim Pot	\$1.00
P1095	20 Kohm Mini Horiz Mount Trim Pot	\$1.00
P1096	50 Kohm Mini Horiz Mount Trim Pot	\$1.00
P1097	100 Kohm Mini Horiz Mount Trim Pot	\$1.00
P1098	200 Kohm Mini Horiz Mount Trim Pot	\$1.00
P1099	500 Kohm Mini Horiz Mount Trim Pot	\$1.00

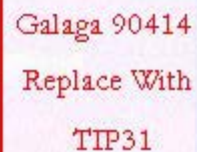
Another variation that uses these pots is the P758 remote board. I'm not sure what model/s use this board, but a couple of the values are significantly different, so I'll list them here, as well.



V101	10K Ohm Trim Pot	Contrast
V102	2K Ohm Trim Pot	Black Level
V103	30K Ohm Trim Pot	Vertical Position
V104	200 Ohm Trim Pot	Vertical Size
V105	500K Ohm Trim Pot	Vertical Hold
V106	500 Ohm Trim Pot	Horizontal Position

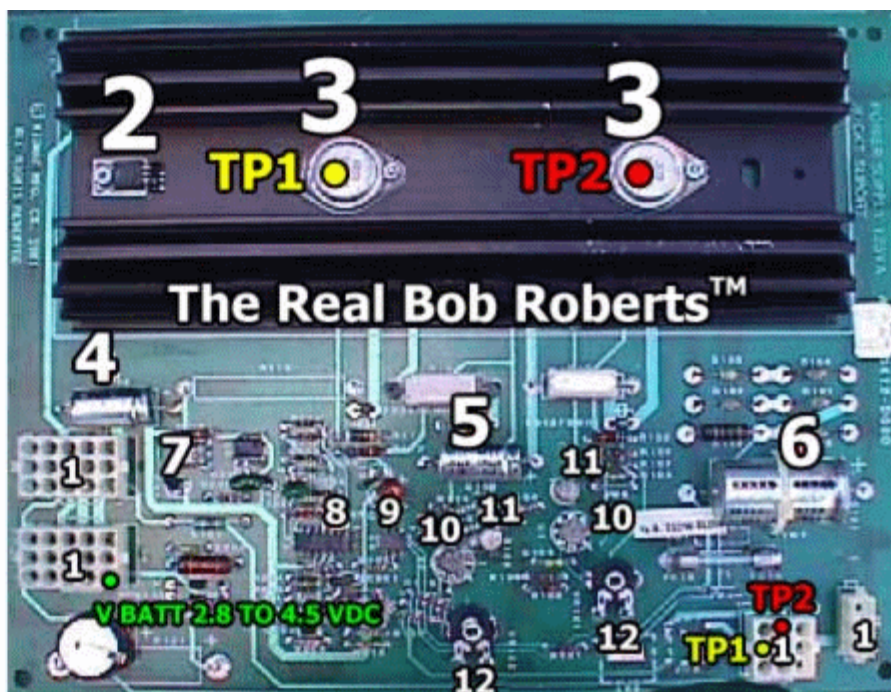






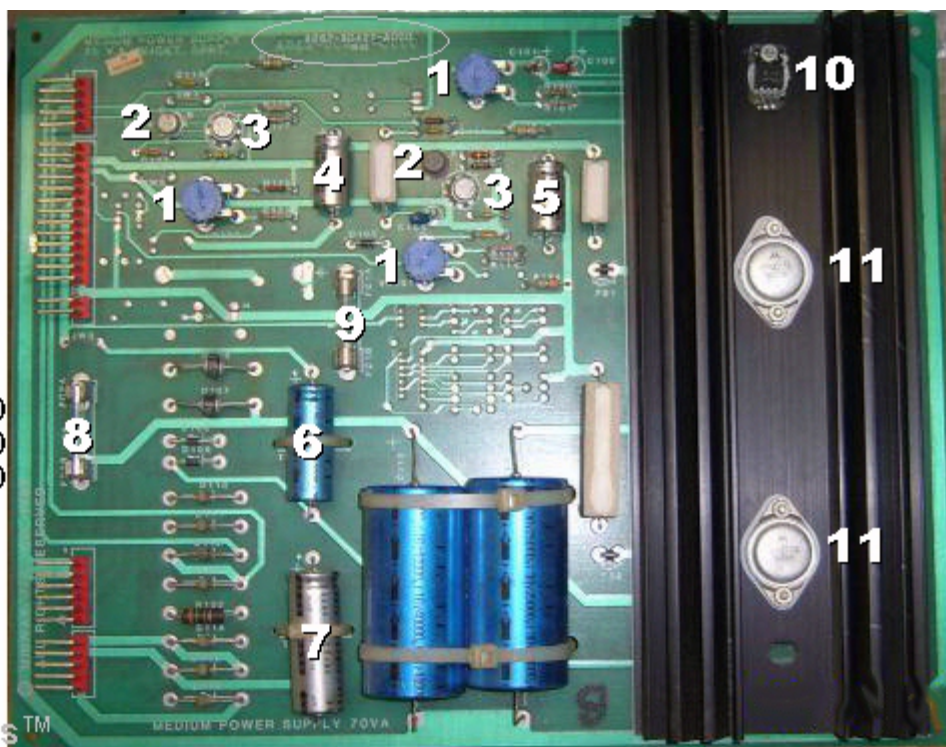
Midway 90412 Linear Power Supply Repair

- 1 Four solder tail sockets
 - J5 15 position with pins
 - J4 15 position with sockets
 - J3 9 position with pins
 - J6 3 position with pins
- 2 TIP31 transistor (Q104)
- 3 2N5301 transistor (Q101/Q103)
replace with 2N3772
- 4 470uf 25V axial cap (C106)
- 5 470uf 25V axial cap (C102)
- 6 4700uf 25V axial cap (C101)
- 7 2N4401 transistor (Q201)
- 8 LM3900N (U3)
- 9 4N28 (U4)
- 10 LM305 (U1/U2)
- 11 2N2905 transistor (Q102/Q105)
- 12 100ohm potentiometer (VR101/VR102)

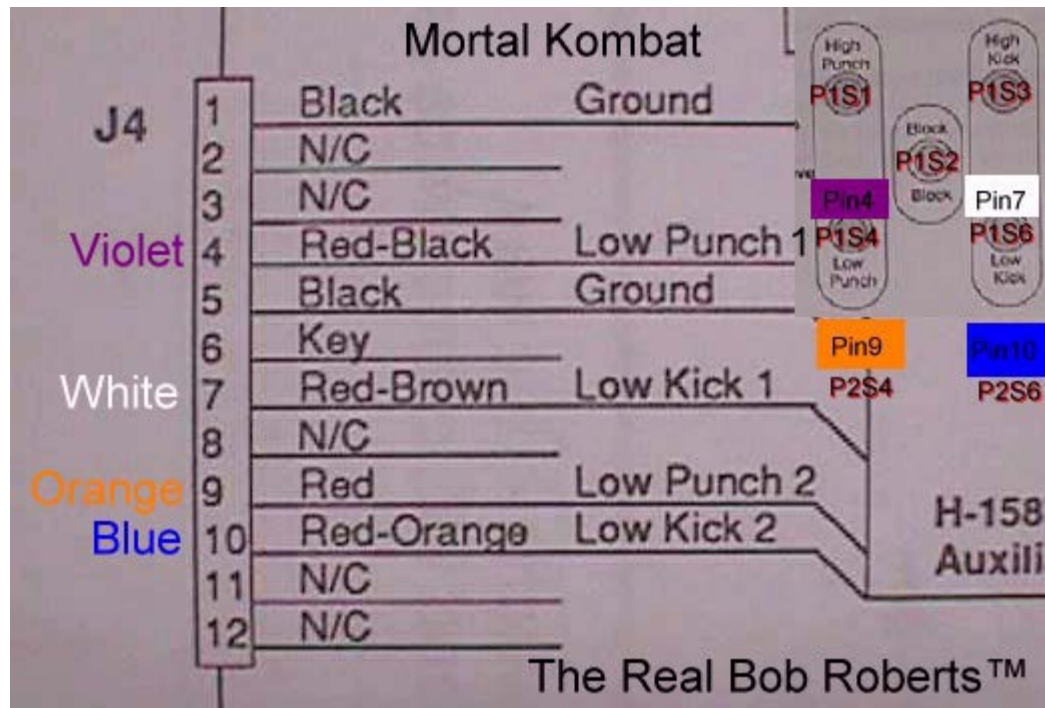


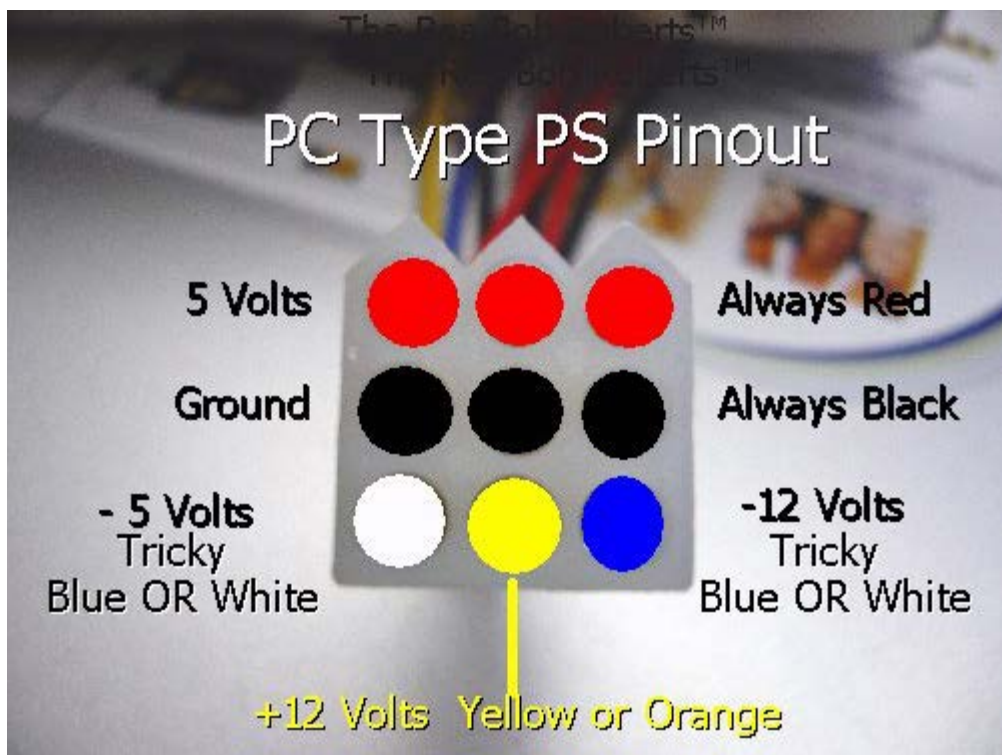
**90421 (90427) Midway
Power Supply Repair Kit**

- 1 100 Ohm Pot**
(VR100, VR101, VR102)
- 2 2N2905** (Q102, Q104)
- 3 LM305** (U2, U5)
- 4 470uf 25v Cap** (C114)
- 5 470uf 25v Cap** (C102)
- 6 2200uf 25v Cap** (C115)
- 7 4700uf 25v Cap** (C116)
- 8 1 Amp FB Fuse** (F2)
- 9 1/4 Amp SB Fuse** (F1)
- 10 7905 Regulator** (U1)
- 11 2N5301 Transistor**
(Q100, Q101)
Use 2N3772



The Real Bob Roberts™

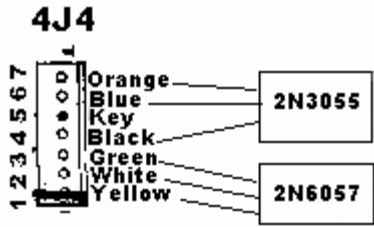
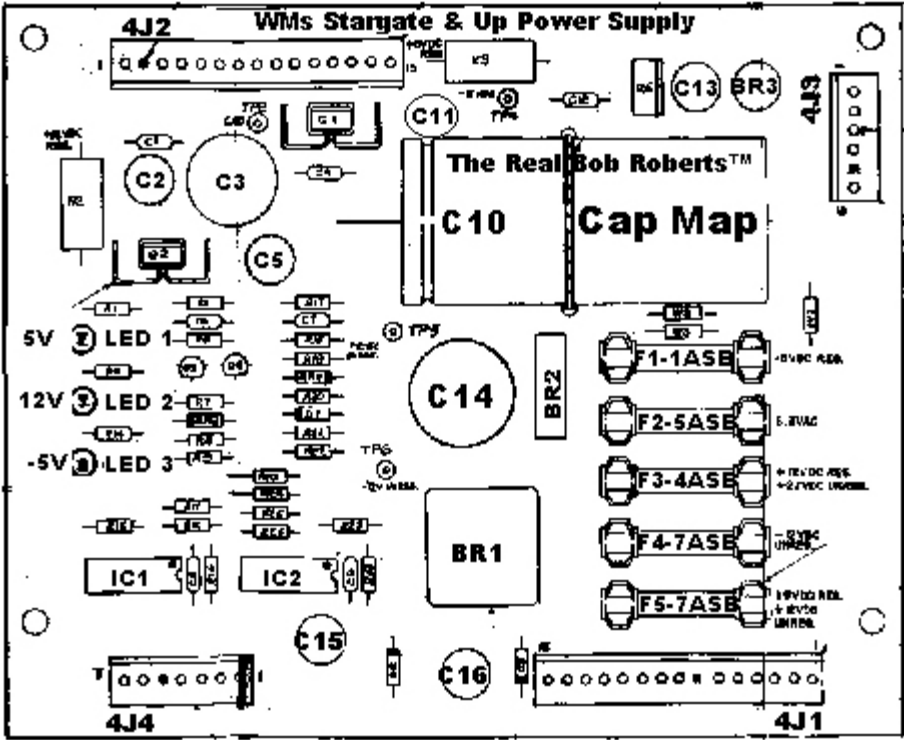


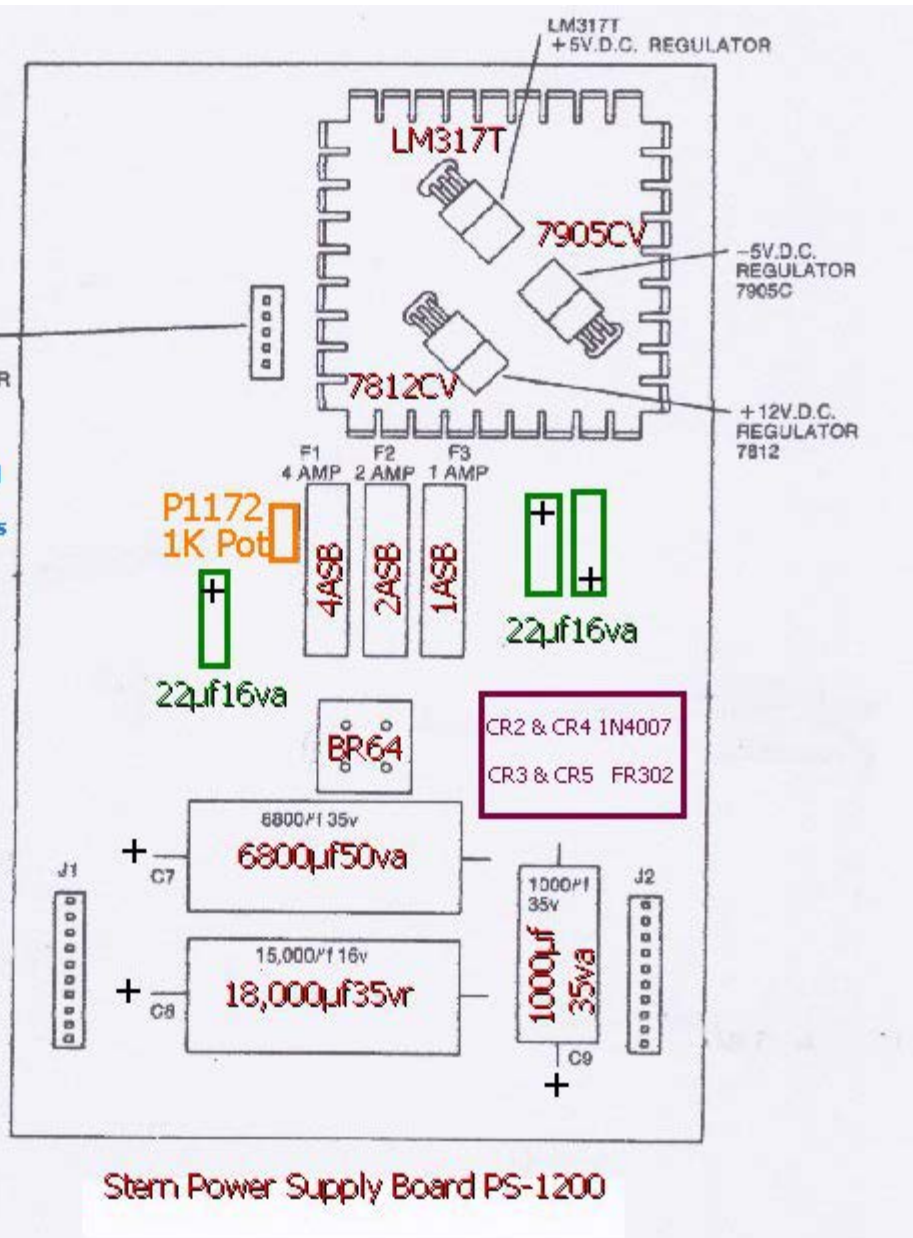


JAMMA > SPM Pinout

PARTS SIDE			SOLDER SIDE		
CPU J3P1	Ground	1	A	Ground	Video J1P11
CPU J3P2	Ground	2	B	Ground	Video J1P9
CPU J3P7	+5 volts	3	C	+5 volts	CPU J3P8
CPU J3P9	+5 volts	4	D	+5 volts	CPU J3P10
NU	- 5 volts	5	E	-5 volts	NU
CPU J3P5	+12 volts	6	F	+12 volts	CPU J3P5
NA	Key	7	H	Key	NA
NU	Coin Counter 1	8	J	Coin Counter 2	NU
NU	Coin Lockout	9	K	Coin Lockout	NU
CPU J1P3	Speaker +	10	L	Speaker -	CPU J1P2
NU	Not Used	11	M	Not Used	NU
Video J1P10	Red Video	12	N	Green Video	Video J1P8
Video J1P6	Blue Video	13	P	Composite Sync	Video J1P2&3
Video J1P5	Video Ground	14	R	Service Switch	CPU J2P6
CPU J2P14	Test	15	S	Tilt	NU
CPU J2P7	P1 Coin	16	T	P2 Coin	CPU J2P7/8
CPU J2P11	P1 Start	17	U	P2 Start	CPU J2P10
CPU J2P3	P1 UP	18	V	P2 Up	CPU J1P8
CPU J2P1	P1 Down	19	W	P2 Down	CPU J1P6
CPU J2P2	P1 Left	20	X	P2 Left	CPU J1P7
CPU J2P4	P1 Right	21	Y	P2 Right	CPU J1P9
CPU J2P13	P1 Button 1	22	Z	P2 Button 1	CPU J2P12
NU	P1 Button 2	23	a	P2 Button 2	NU
NU	P1 Button 3	24	b	P2 Button 3	NU
NU	P1 Button 4	25	c	P2 Button 4	NU
NU	P1 Button 5	26	d	P2 button 5	NU
CPU J3P3	Ground	27	e	Ground	Video J1P7
CPU J2P15 NO	Ground	28	f	Ground	CPU J3P4

The Real Bob Roberts™





Street

Fighter

Original Version

Confirmed by John Parkinson Jr

PUNCH

LIGHT

MIDDLE

HEAVY

KICK

Player 1

P1S4

P1S5

P1S6

Player 2

P2S4

P2S5

P2S6

CN6

Spk 2-

Spk 2+

Spk 1-

Spk 1+

.100 Molex Stereo

MOLEX .093 4 POSITION

ONE SIDE STAYS WITH JAMMA HARNESS

OTHER SIDE STAYS WITH SF PCB

4 3 2 1

CN5

P2S1

P2S2

P2S3

P2S4

P2S5

GND1

GND2

GND3

JAMMA

FROM BACK

CN5

P1S1

P1S2

P1S3

P1S4

P1S5

GND4

GND5

GND6

JAMMA

PARTS SIDE

October 25, 2001

JAMMA PLUS CONNECTOR

Molex 6 pos .093

1 2 3 4 5 6

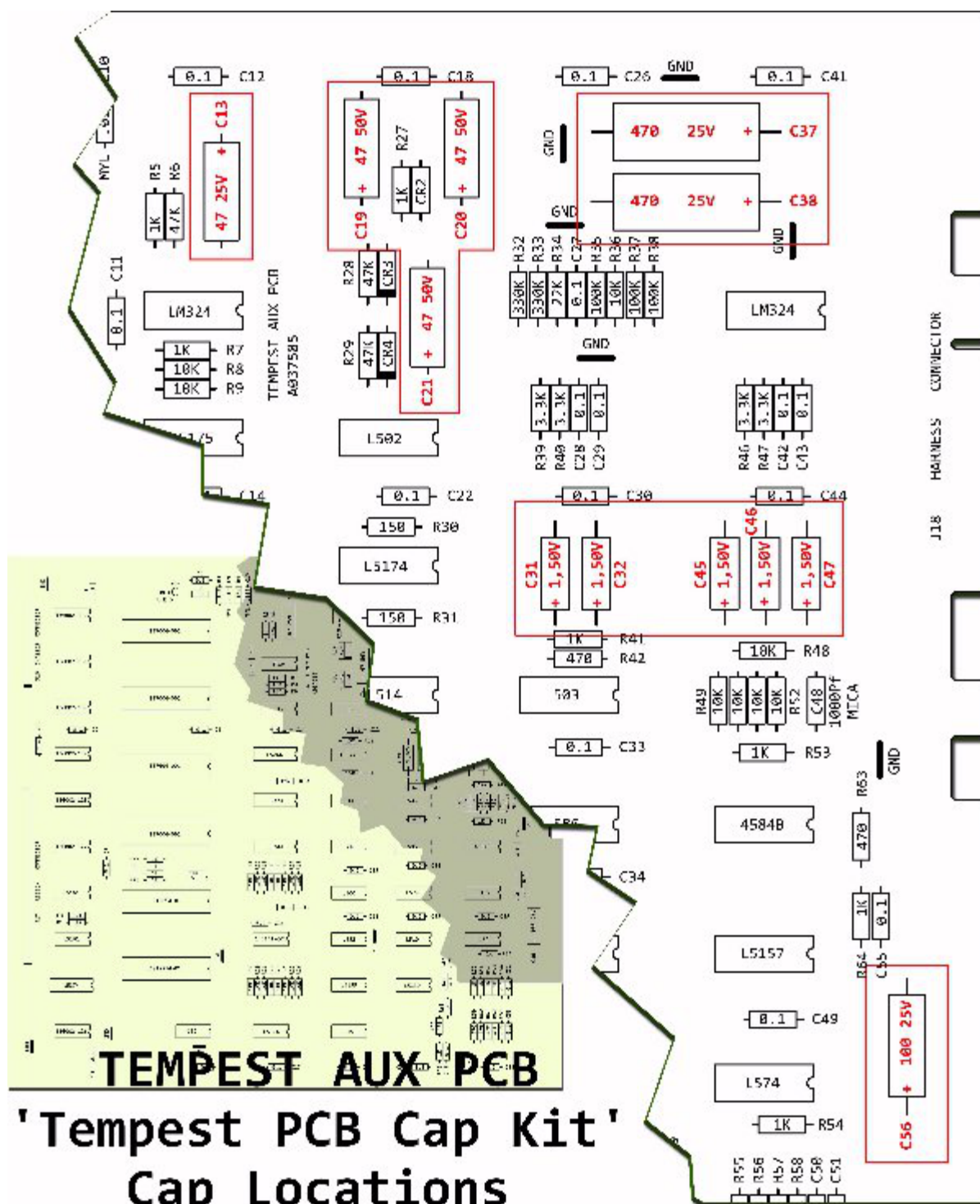
PCB Half

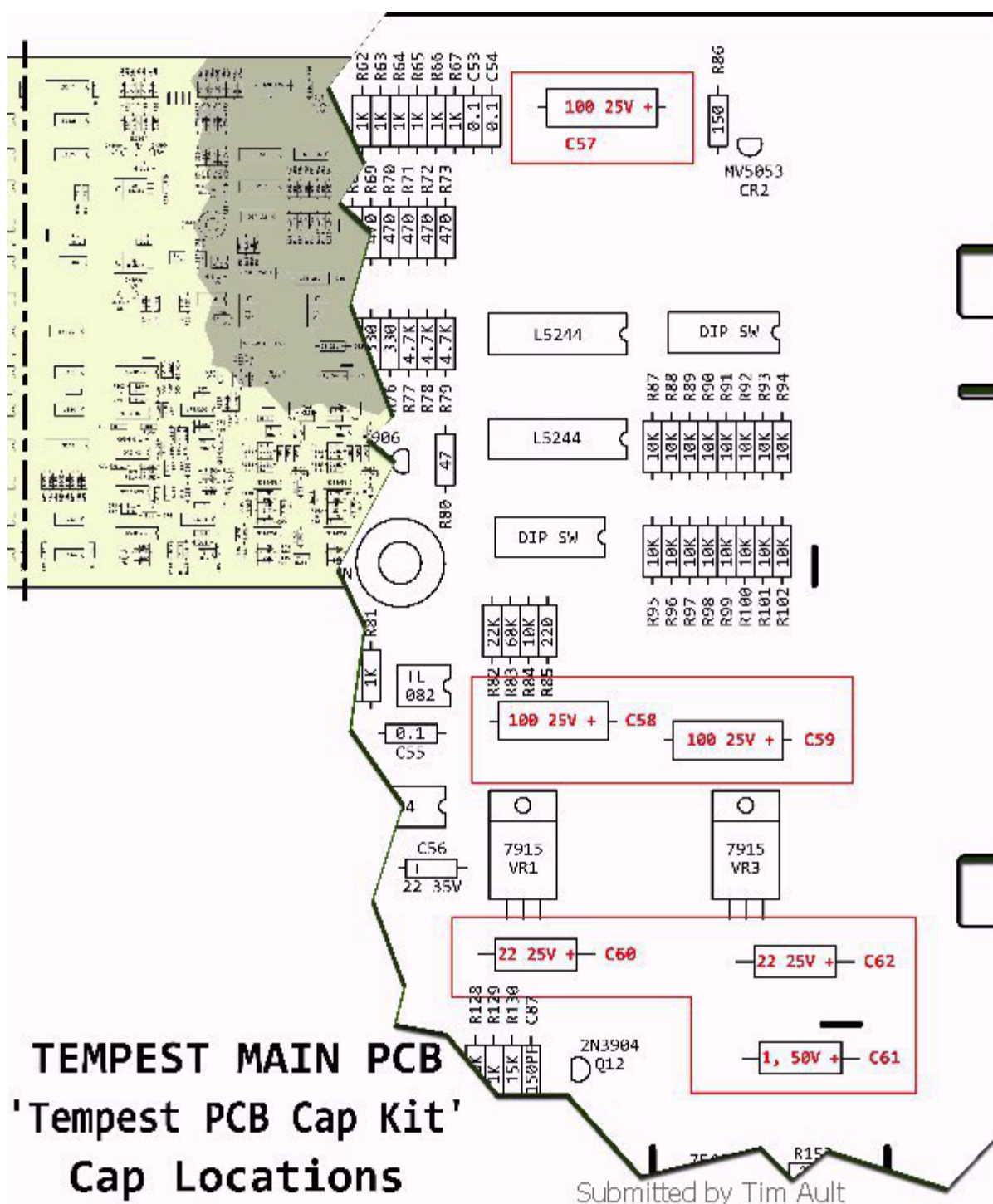
CN5

To CP

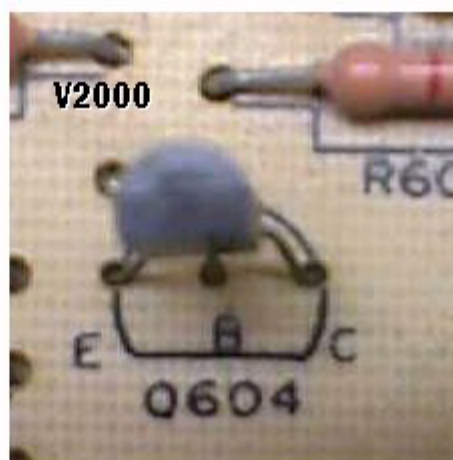
JAMMA PINS

The Real Bob Roberts™



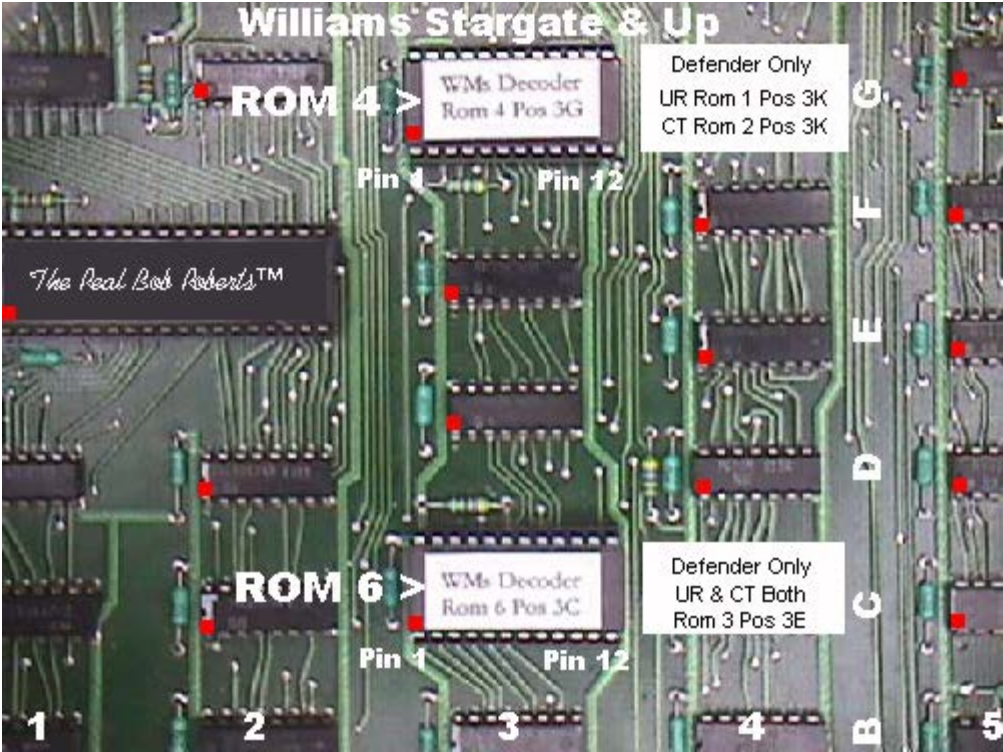


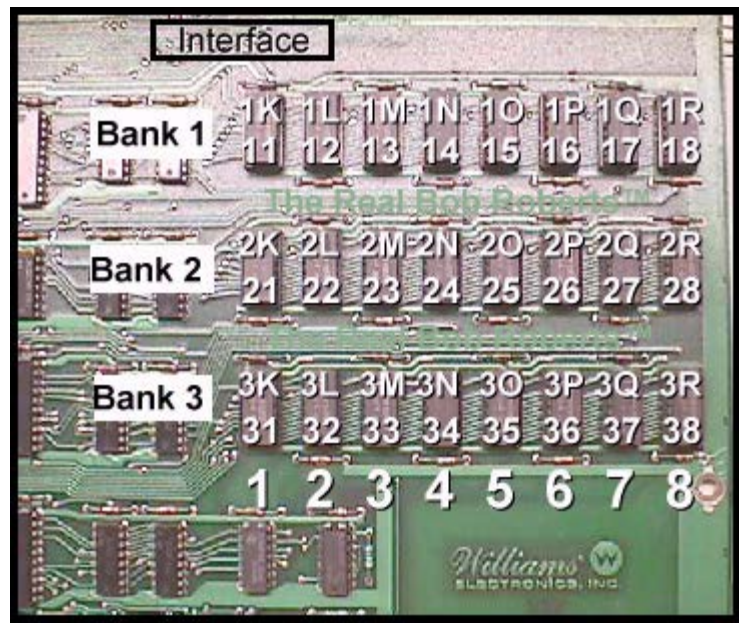
TPS98 -- TIS98 -- 127-001 Used On G05 - V2000 - K6100

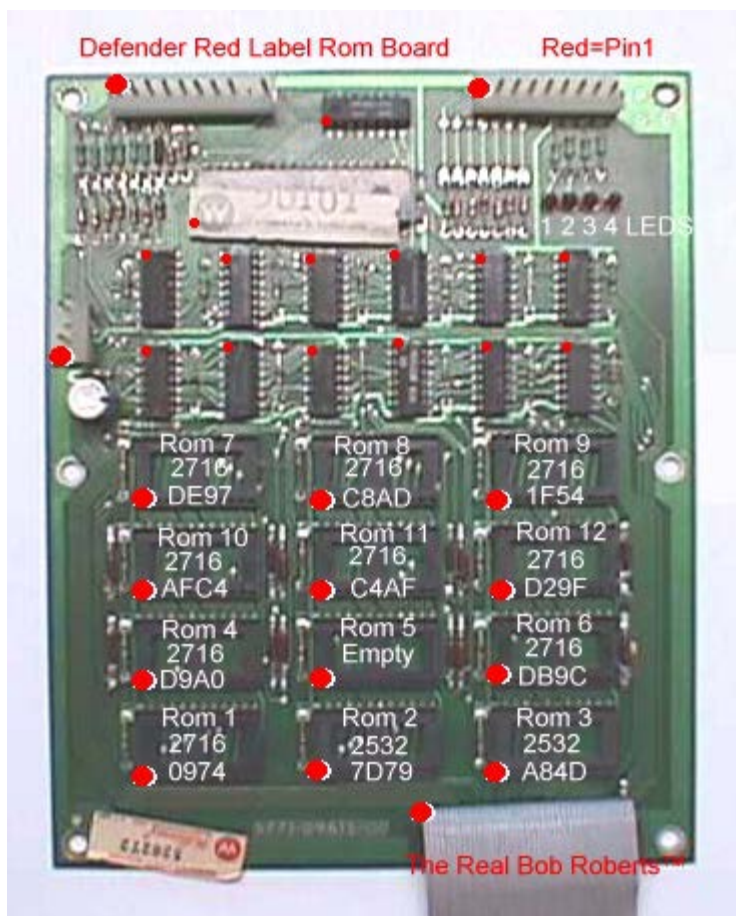


The Real Bob Roberts™

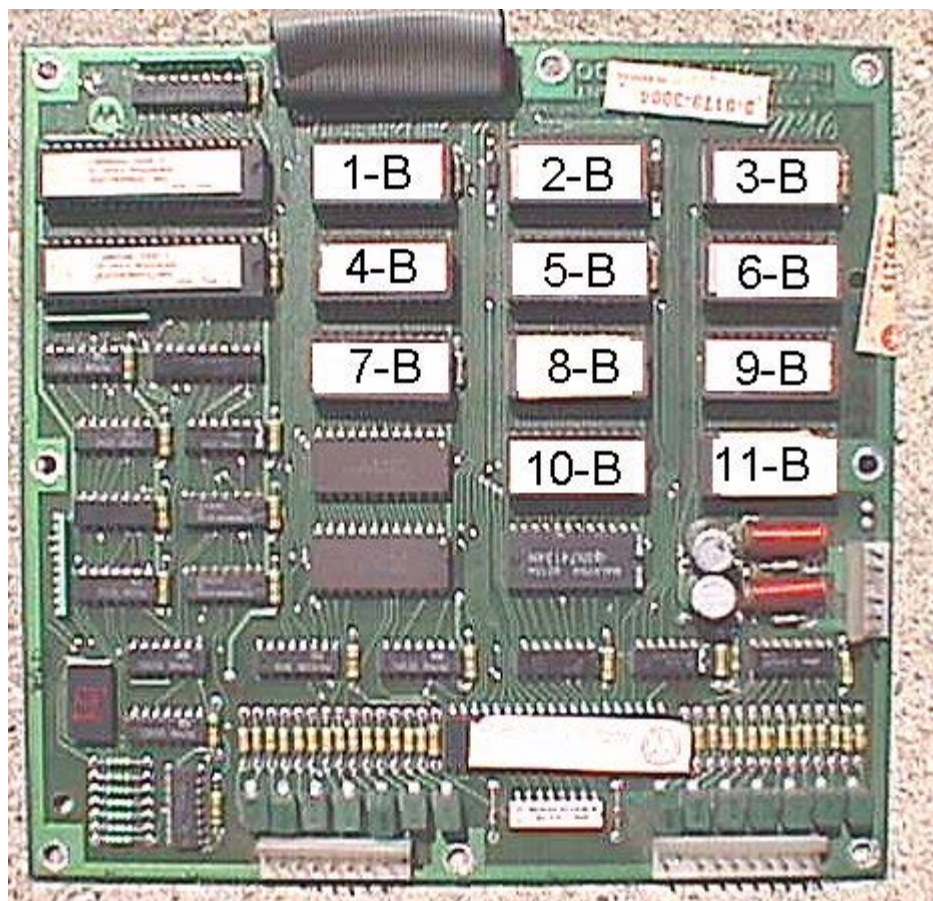
The subs we ship are EBC and will correspond to silked EBC on PCB. Notice that the G05 has OEM TPS98 installed & although the silked positions are correct, the xsistor outline is reversed. Other chassis PCBs are pic'd correctly, so always go by the EBC.





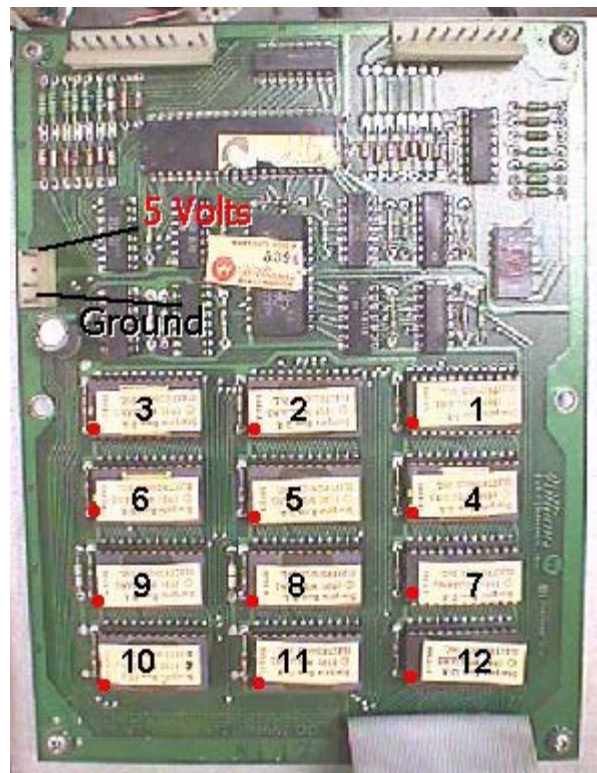


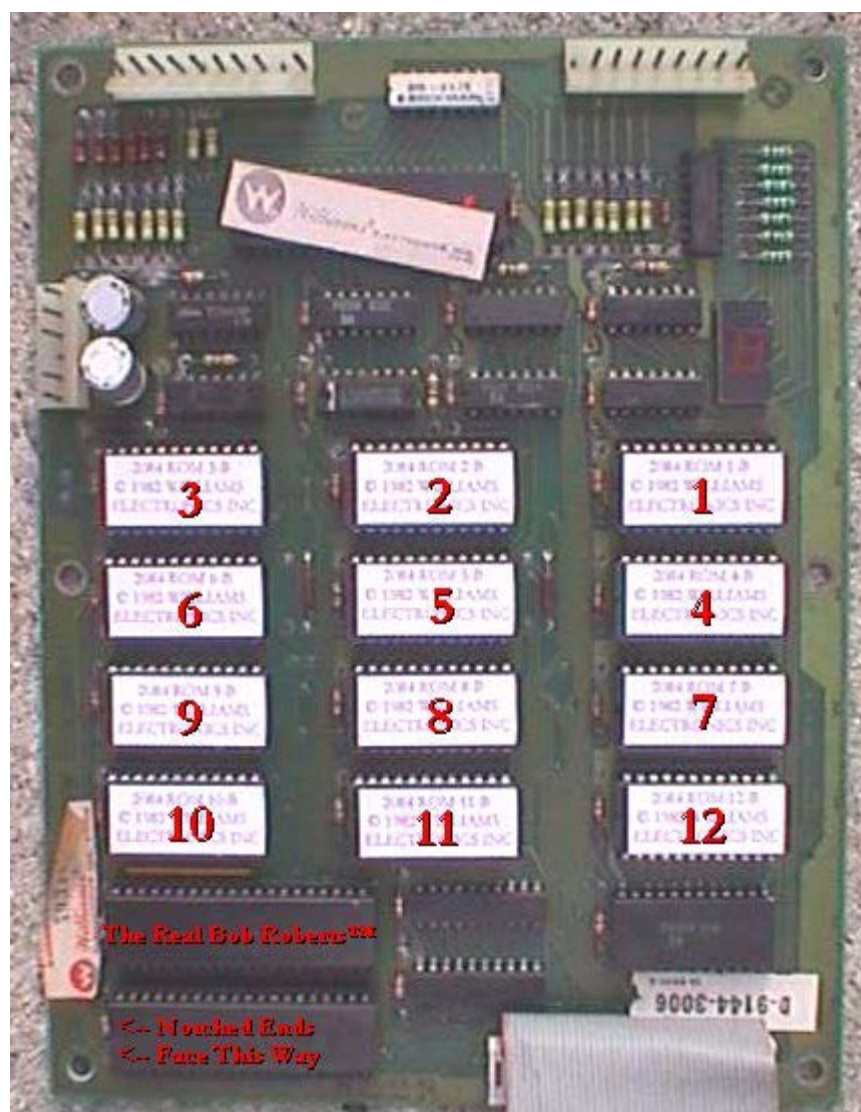
Williams Sinistar Rom Board Layout Map

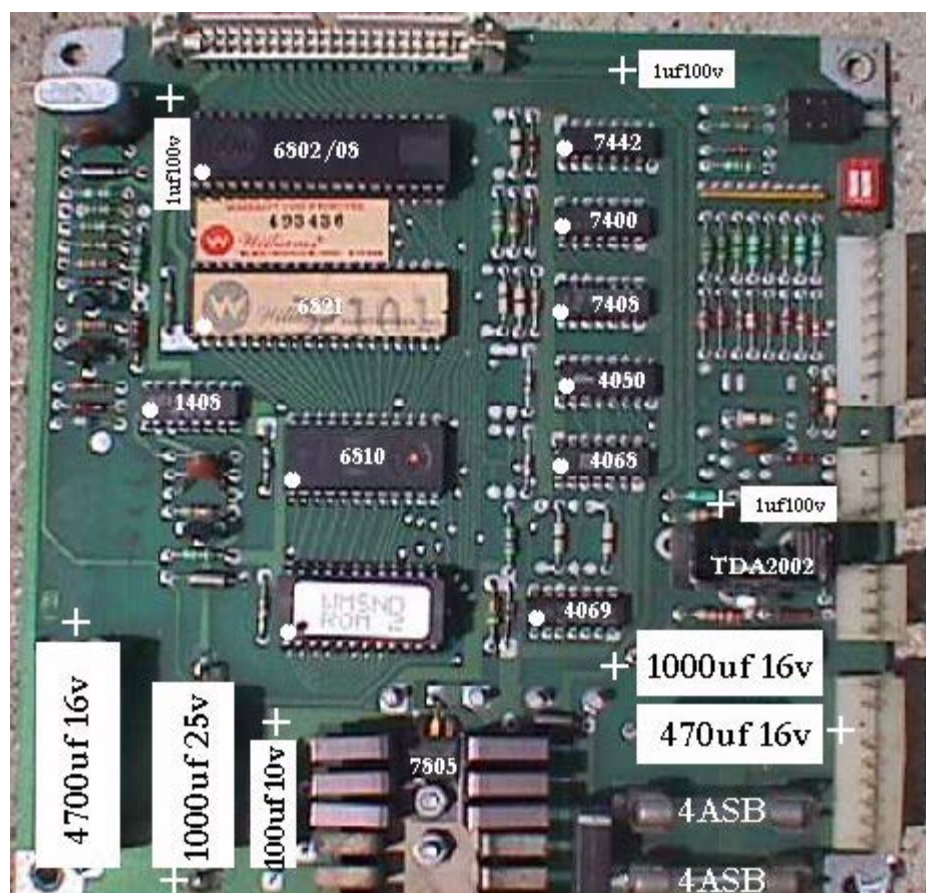


Like many of the Williams games, Sinistar had labels on the roms from right to left making them upside down to all other print on ICs & the PCB. This causes the ID notch for pin 1 to be on the right side of the chip instead of the more common left side. Placing roms in backwards renders them to paperweight material, so *ALWAYS* check to be sure that the notched end is in the correct way...usually, all notched ends of chips on a PCB will be in the same direction, but trust in your eyes & mating pin 1... notched end of rom... to pin 1 of the socket as marked on the PCB, because many times the socket itself will be mounted backwards!

The notches on the rom board above are all on the right side as pic'd. Once again, *NEVER* use the label as a guide for inserting any roms, proms or eproms!







Alice... Where's Our Helpers?

Well... these hot summer days when the help doesn't show up we know right where to look!



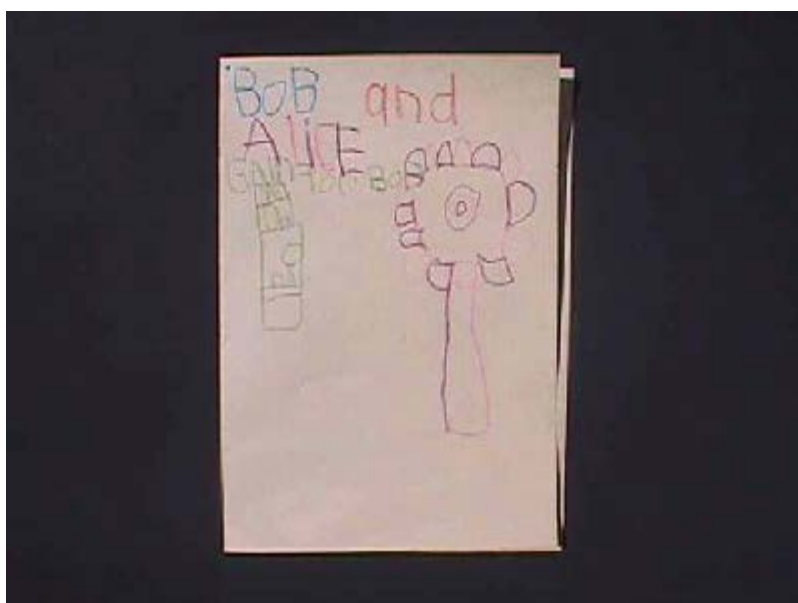
They say a water hose & a little dish detergent is all you need for speed! Once at work I hear, "I hurt my hand". How did you do that... pulling wire? Oh no... you see there was this brick under the plastic at the slip & slide & I hit it on the way down!

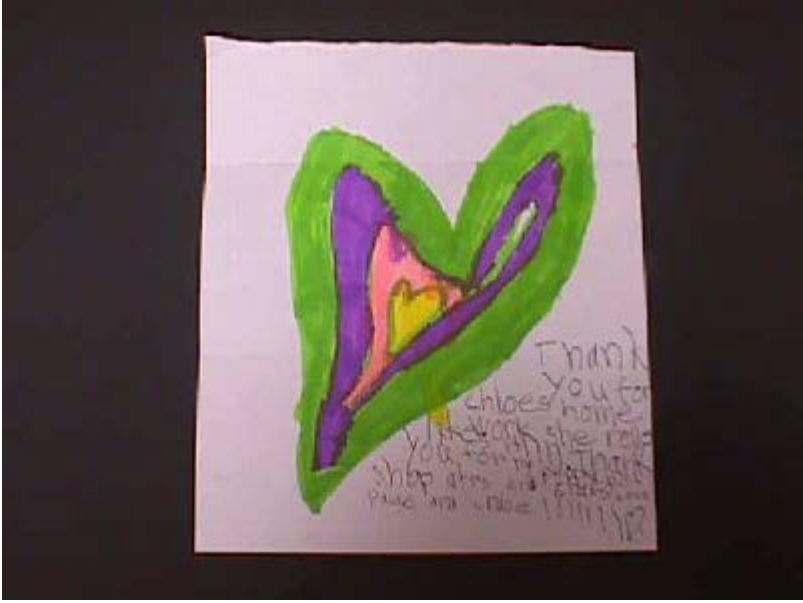
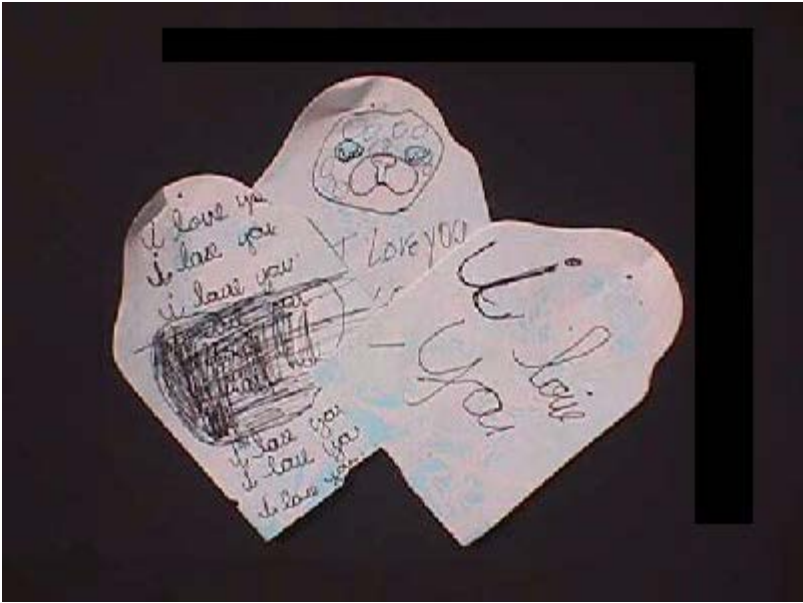
But then there's our grandson the party goer... doesn't show up to work... he's at his other job!

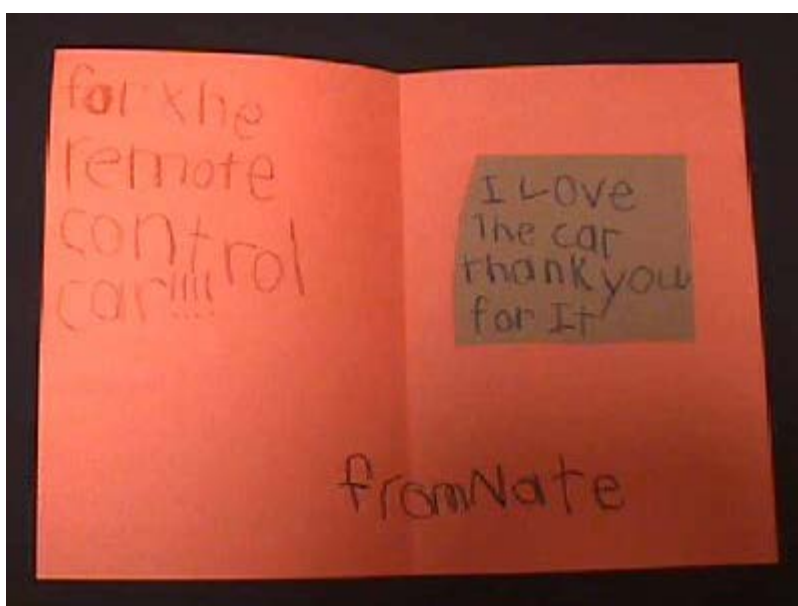
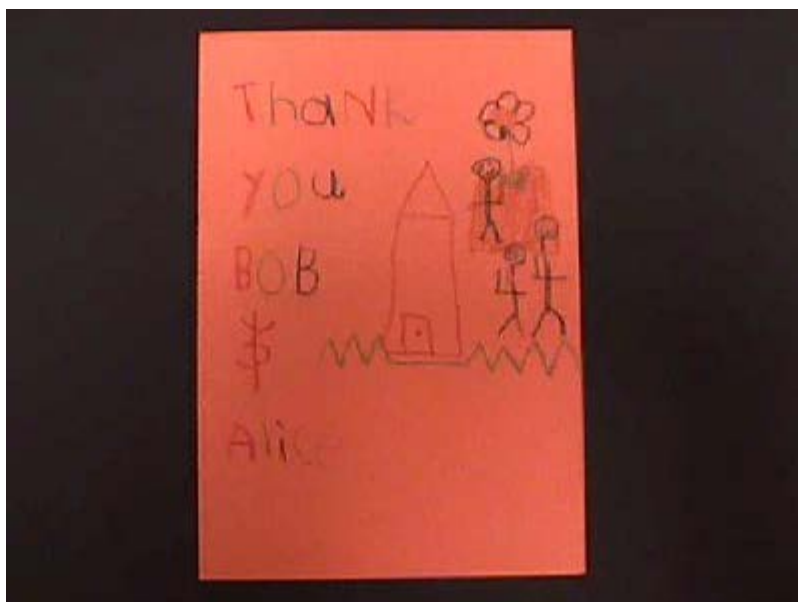


Alice keeps asking me to put a "Kids Korner" here to showcase our art work that we've received from the next generation of gamers, so I thought I'd just drop an olio of masterpieces in here to appease her until I can find a spare minute to accommodate her wishes.





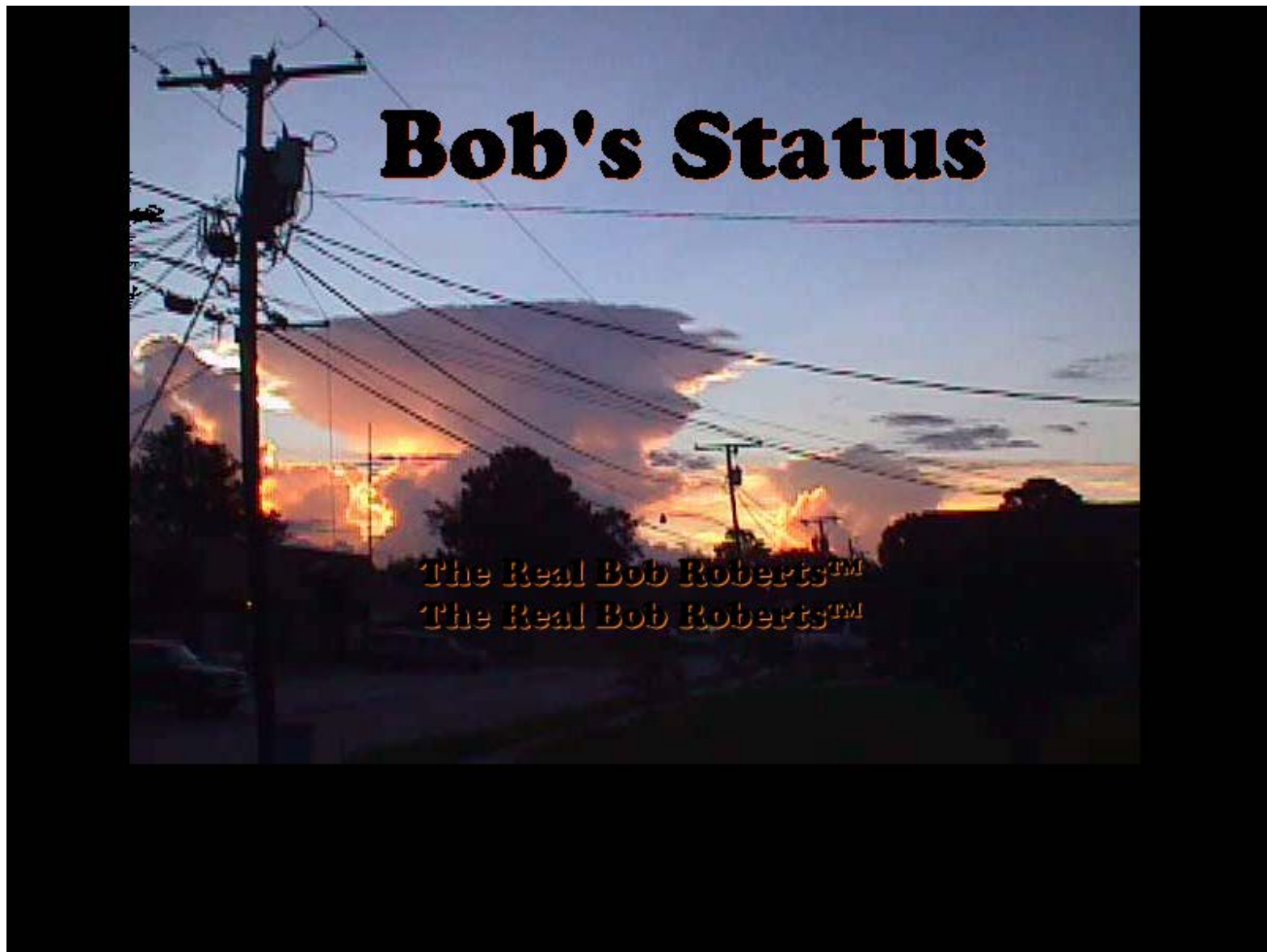








Are your collections coming up short?





















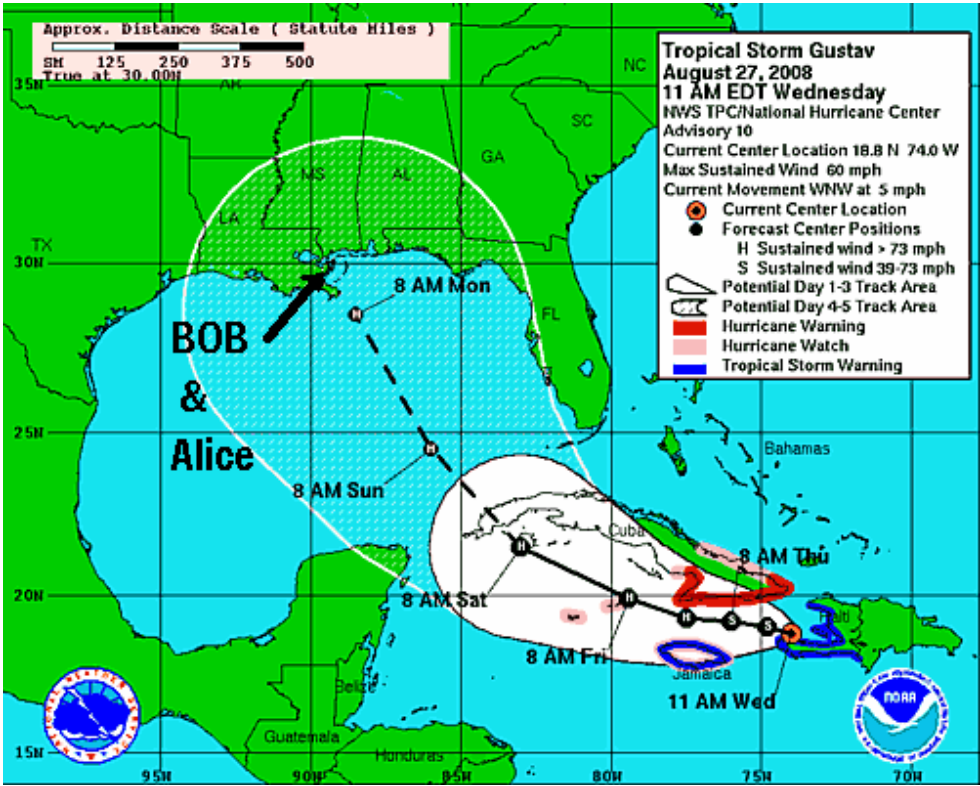






Sale Page







WAVES OF TROUBLE



STAFF PHOTO BY RUSTY COSTANZA

Traffic stays to the left on Terry Parkway between Carol Sue Avenue and Belle Chasse Highway in Terrytown on Monday. The National Weather Service issued a tornado watch for the entire metropolitan area Monday, as a line of heavy thunderstorms in advance of a cold front approached. Today's forecast calls for more thunderstorms.









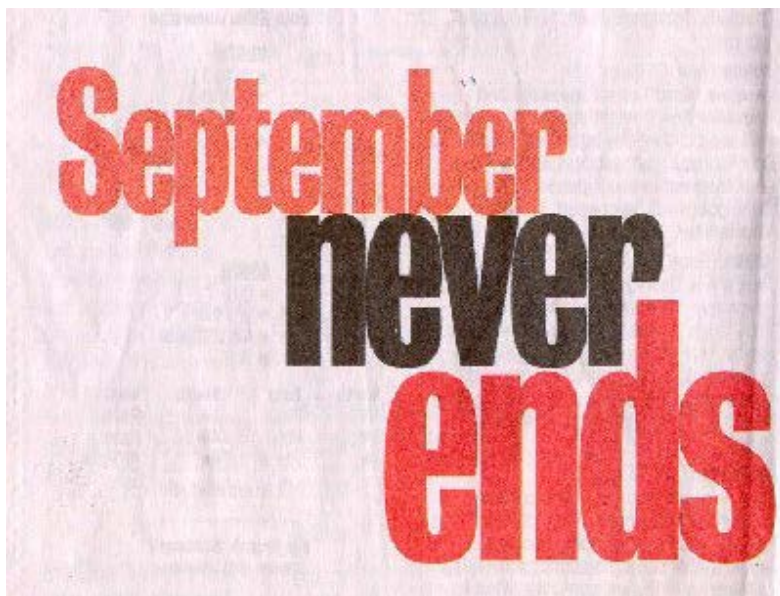




[cats](#)
[racoons](#) [opossums](#)

[cats](#)

[regular](#)





STAFF PHOTO BY TED JACSON

man with his dog stands in front of the pile of debris that used to be his home, courtesy of the tornadoes that tore rough town last week.



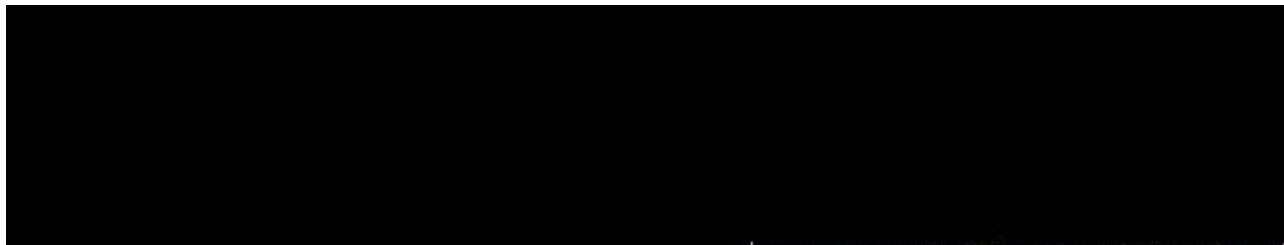




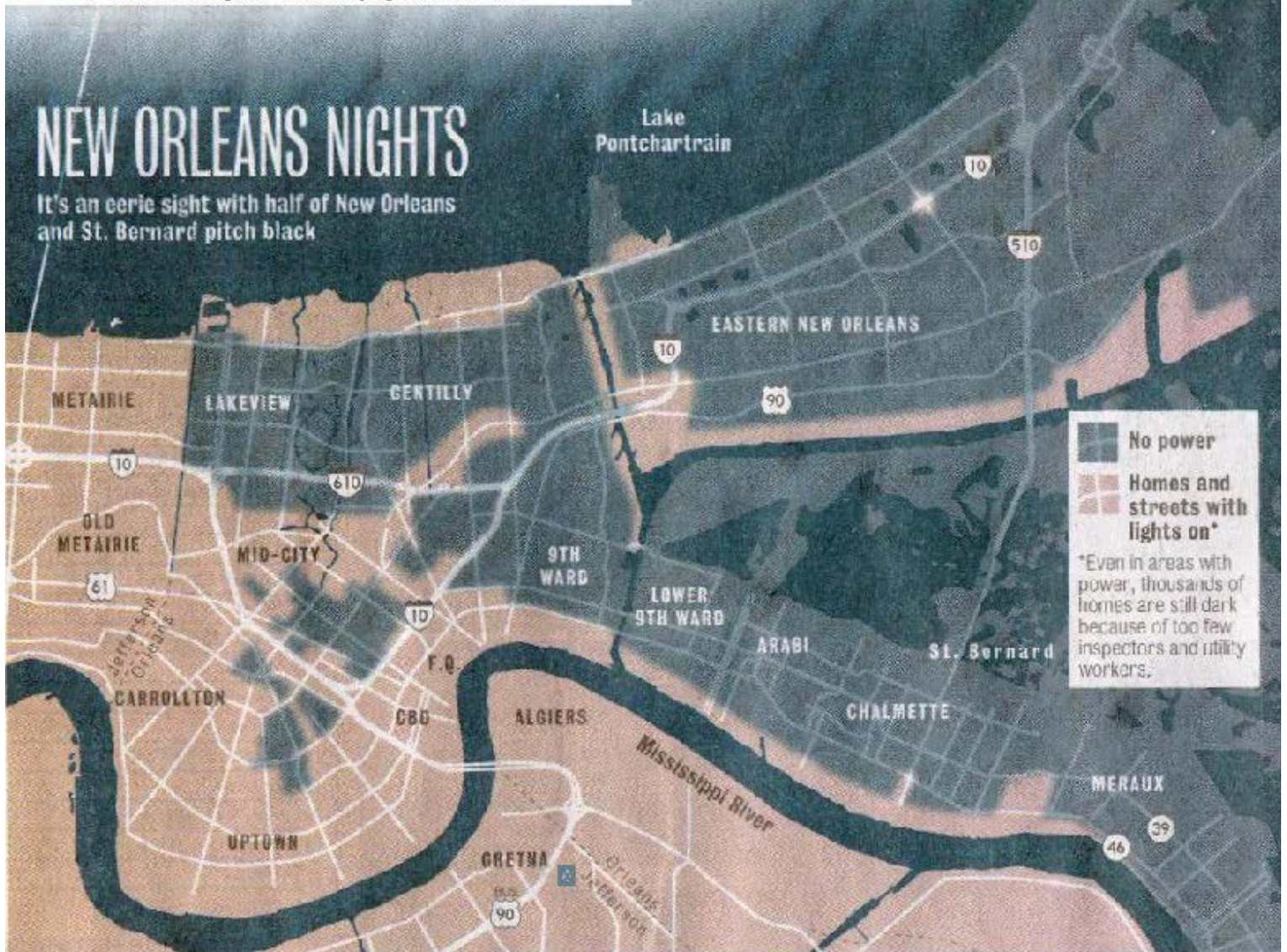




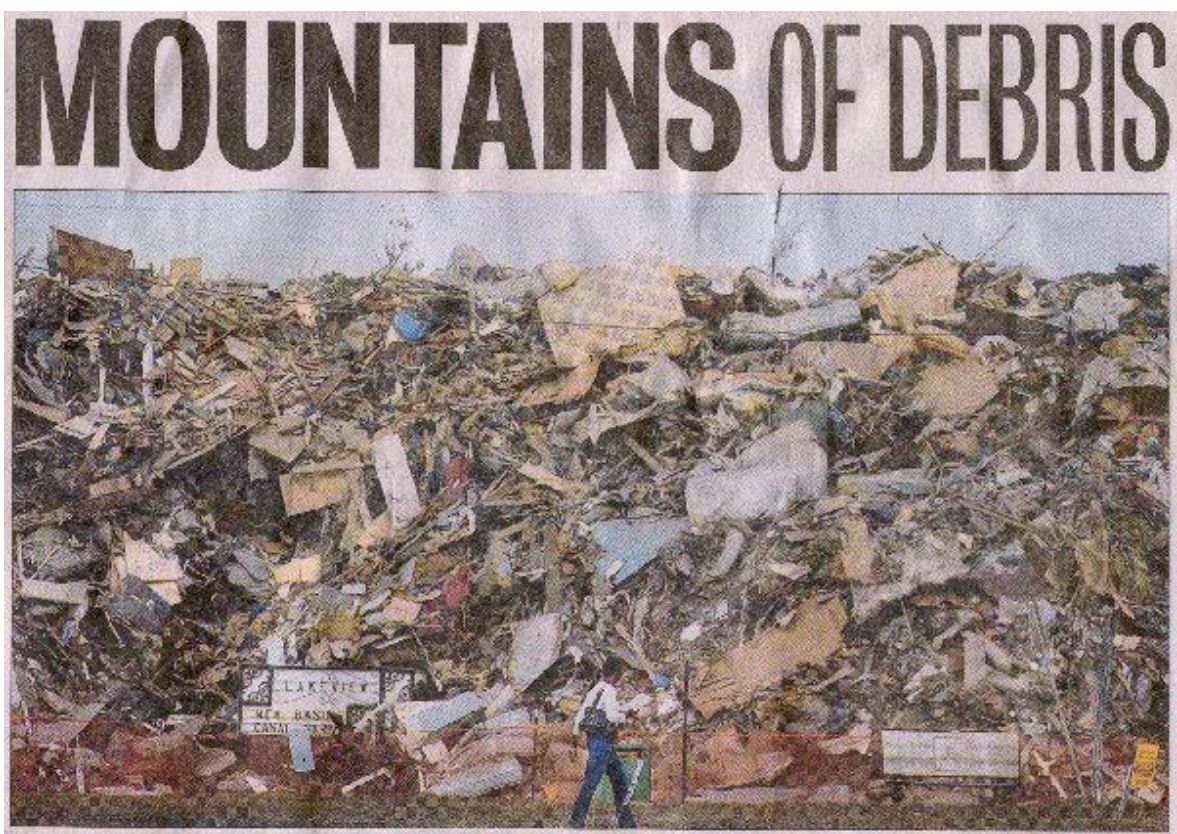




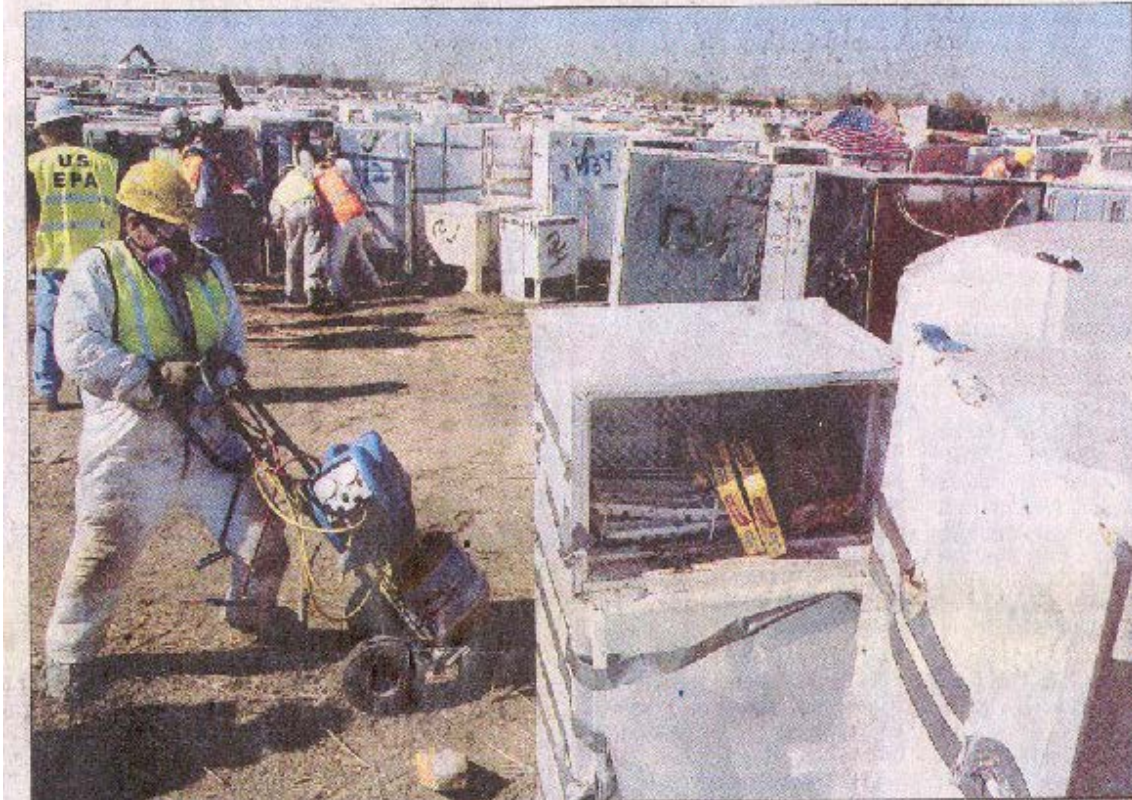
The Times-Picayune - Staff Map By Dan Swenson



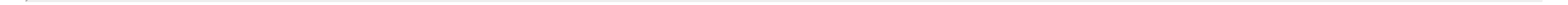


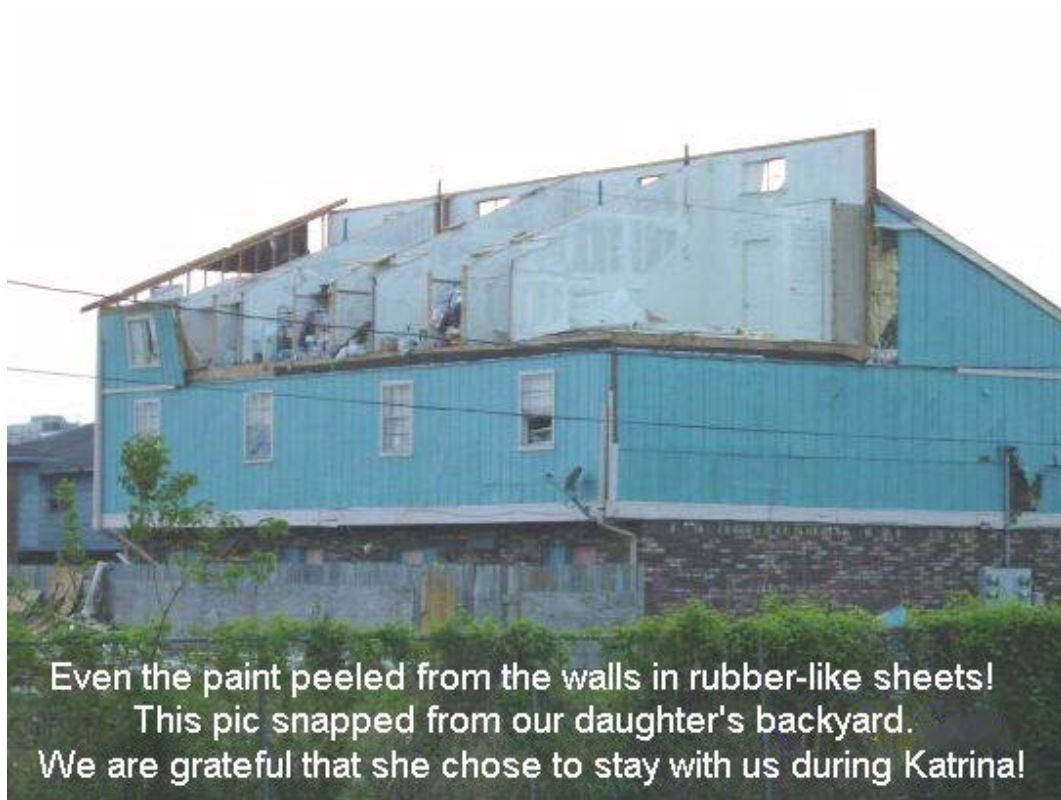


WHITE ELEPHANTS









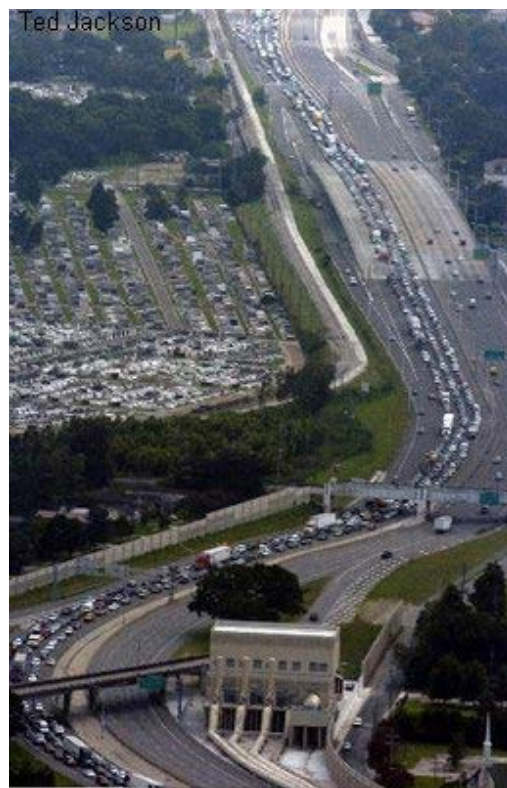
Even the paint peeled from the walls in rubber-like sheets!
This pic snapped from our daughter's backyard.
We are grateful that she chose to stay with us during Katrina!





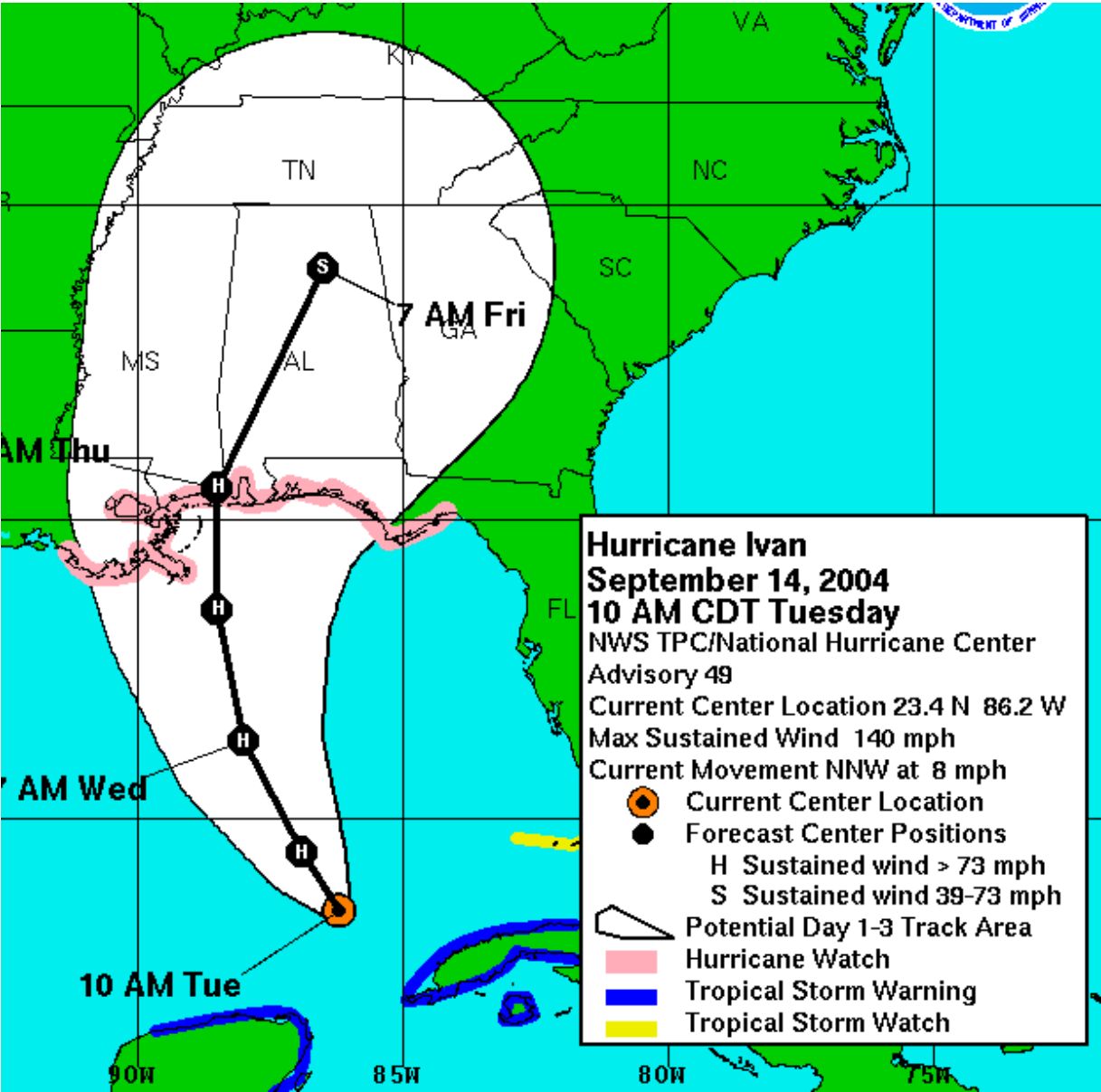
THANK YOU FAITH & HOPE













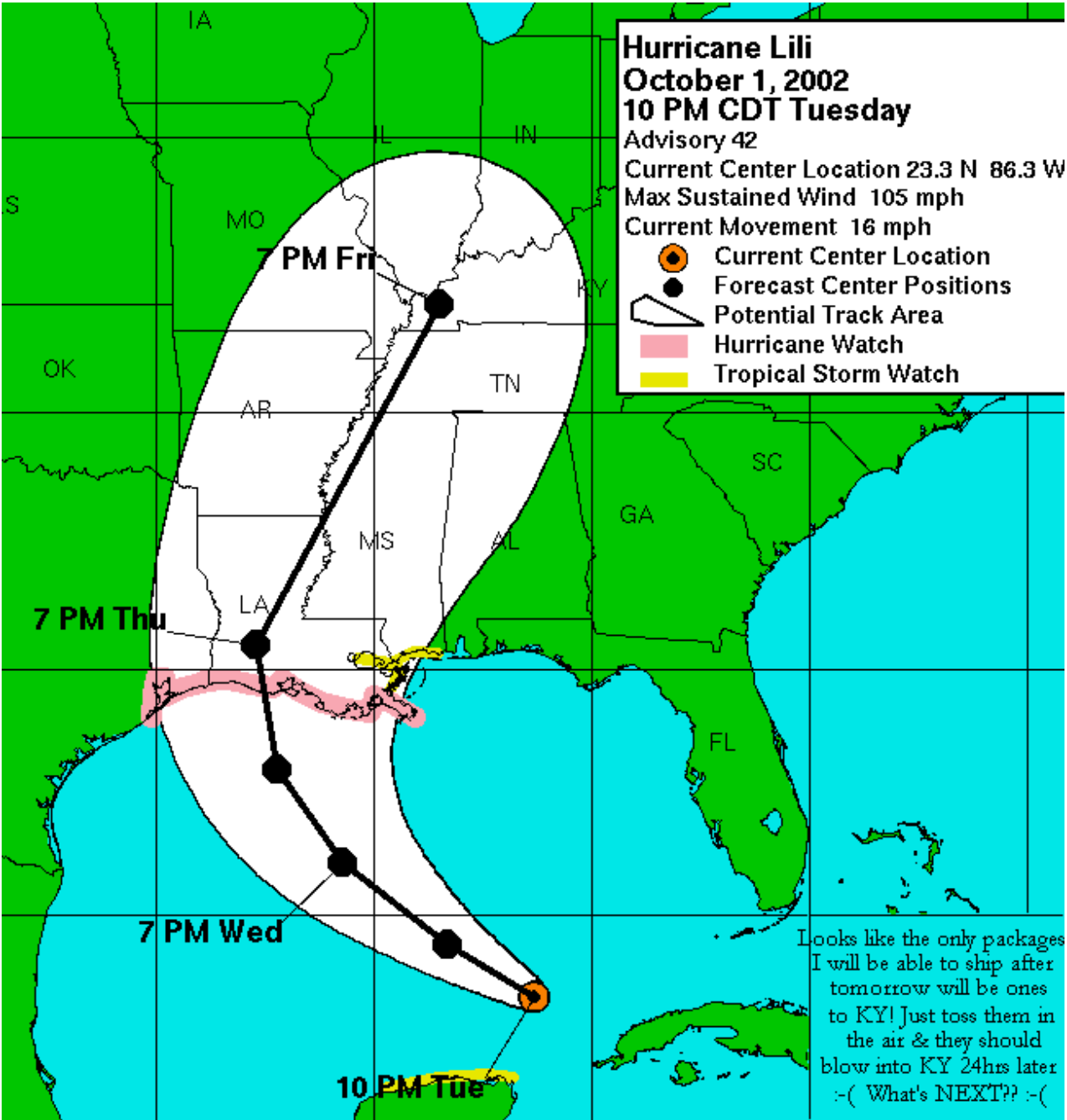




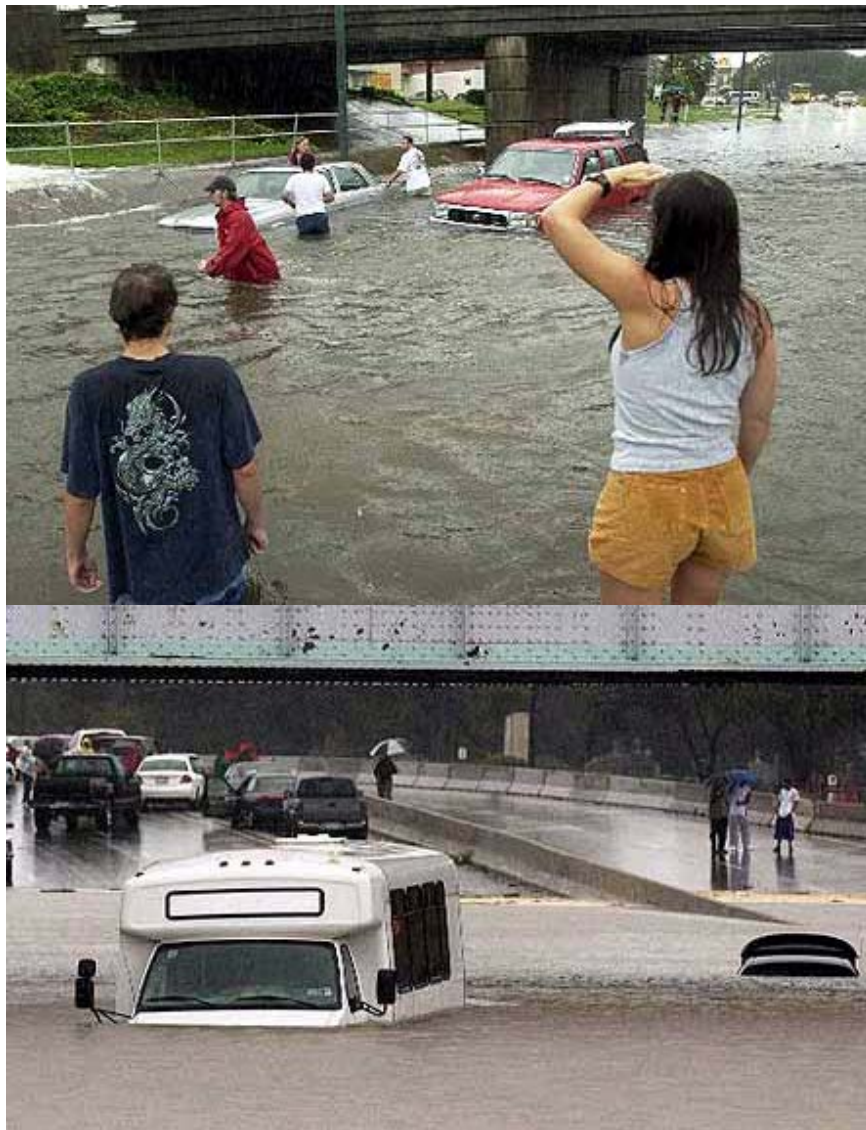














The Mysterious Bob Roberts

by **Andy R**

Bob was born in Louisanna. At the age of 2 he was abandoned by his parents and raised by the Operators of a local arcade, where he learned to speak their language and interact with other Operators of other arcades. By the age of seven he showed promise as a child prodigy and composed his first work, The Magic Fluke. (Hollywood eventually made a movie about this part of his life called "Dances with Operation Wolf's")

By the time he reached 14, he had found Mrs. Bob, and they were soon wed, which worked out for her because people could never figure out why she was called Mrs. Bob. By 21, Bob had amassed a fortune in Atari lighted pushbuttons and 1/2 ohm resistors. Had it not been for the accident in which he dropped an Electrohome G07 on his foot, he might have ruled the 1/2 ohm resistor market. But it was not to be.

5 years after his 21st birthday, Bob turned 64 years old (marriage will do that to ya) and he decided to retire. January 1st of the year 2000, Bob's business will officially be sold to the Greater Louisiana Waste Disposal Company, who is turning his business into an electrocution related theme park for criminals on death row.

(I know there are alot of years in there that I kind of glossed over, but Bob is a very humble guy and I know he didnt want me to mention anything about the time he saved the planet from starvation by inventing sliced bread, or the time he invented 'ice'. Thats just Bob...)

Andy r

Update:

I just wanted to add that by age 23 I had escaped the horrible Operators, but on my own only a few weeks I experienced my first incident that would remain with me for the rest of my days. In following this advice:

- How A Monitor Should be Discharged -

I believe the best way to discharge that monitor is to buy 300' of 10 gauge wire, strip back about 2' on one end & about 18" on the other, then wrap the 18" end onto the monitor frame... preferably through the handle portion where you pick it up... and then take the end that is stripped back 2' & run it out to your automobile, making several turns around the bumper... be sure to be in the chrome... and then, and only then, you should be able to slide a screwdriver up under the anode lead for discharge without getting a shock, but if you should get a shock anyway, then you are all set for phase 2!

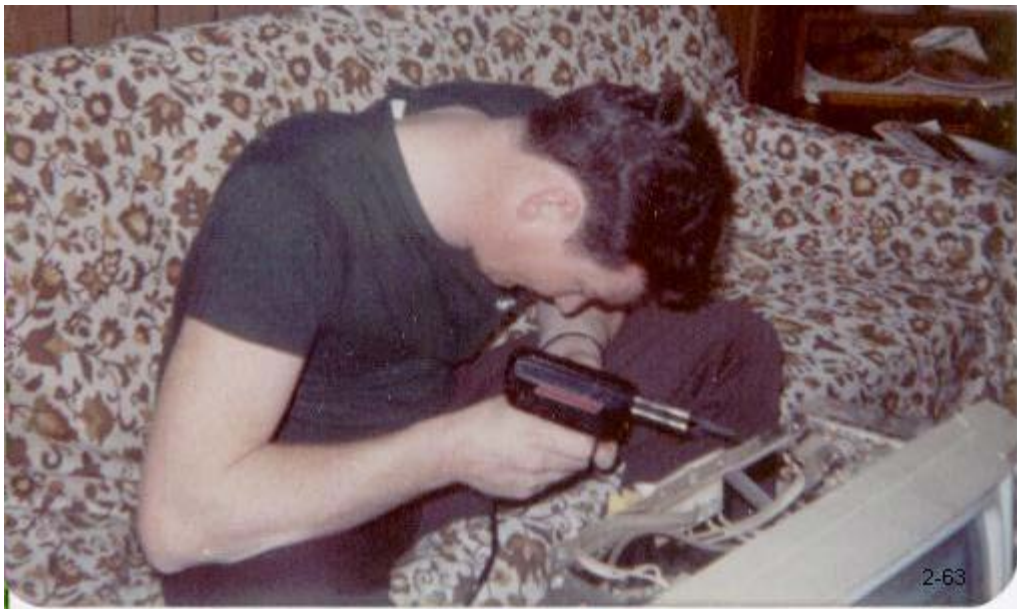
Phase 2:

Insert key into automobile ignition, turn, start engine & drive away!

Monitor problem solved!

--End--

Well... after putting 10 road miles on that first monitor I was so shook up that the first time I picked up a soldering gun I gripped it so tightly that no one could pry my fingers from it & it has been a hindrance for me ever since. Of course, I have to hide it while out in public & I have to always hear the same question on the job site over & over, " How did you get that soldering gun out so fast?" or the quick quip, " I didn't see you bring your tool box in!" Anyway, the gun that has been attached to my hand for many years now is old & useless, but here's a pic of when it first happened & you can see how hard I was trying to pry it from my hand!



I guess the one good thing that came of this was that I am now one of the fastest lefties on the keyboard... the down side to this while learning was it took me 14 keyboards before I finally learned to keep my right hand/gun from trying to help out!

Bob "The Gun"

[Back To The Site Index](#)

Email Aug 09

It has just come to my attention that some emails are not getting here. All email is funneled thru bob147 at Bellsouth which was repurchased by Ma Bell who in turn has recently farmed out the email to Yahoo. We already knew large hi-res pics didn't make it thru, but since this latest transfer of reins it has been determined that using all 3 email addresses are preventing emails from getting thru somehow. I've had 3 confirmed cases now, so I thought I had better make a note of it here.

Undeliverable Email

Every so often emails come bouncing back to me & after exhausting every means to reply to the person, I notice that sometimes by the 3rd & 4th emails they tend to be a little less pleasant :-(

There is not much I can do when the recipient's mail system doesn't let me in for whatever reason & returns all the email with the various explanations :-(I'm sure y'all have gotten some of these messages, also... you know the ones...

This e-mail message was undeliverable due to the following reason:

- The recipient's mail system is turned off.
- The destination mail system is not currently running.
- The destination mail box is full.
- Host xxx.com is not responding.
- The destination mail system refused to accept your e-mail message.
- The recipient has a mis-configured account.
- The destination mail system rejected your return address.
- The address of the destination mail system is not configured correctly.

...and the list goes on... & on!

It has occurred to me that I can post these refusals here, so that you can see if I have had trouble getting back to you. If so, perhaps it will give you a chance to try an alternate email address or maybe get a friend to try to retrieve your reply. Of course, I won't use the complete email address for obvious reasons.

Recent Undeliverable Email Returns:

blake.fischer Host not responding

oasis_liam8

J Corrill entergy

boss.jpg %d×%d pixels



THE REAL BOB ROBERTS™

SITE INDEX

[Do you have a link to this site posted on your site?](#)



[9-11-01](#)

10/22/16..... We are temporarily closed... we are not taking any new orders or offering advice. We are completing all current transactions & receiving all outstanding payments till we are caught up. We will reopen as soon as possible. Sorry for any inconvenience this may cause. -- Bob & Alice



[All Sales Final](#)

[Adaptors](#)

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[These are the only working email accounts since the crash.](#)
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[Contact Bob](#)

[Contact Bob](#)

[Hey! Your email is bouncing!](#)

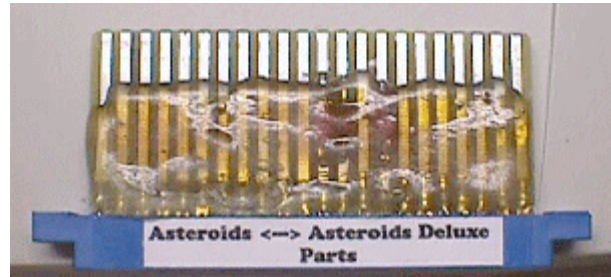
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[Employees Only](#)

[***Rewind***](#)



For All Your Coin-Op Parts
The Real Bob Roberts™



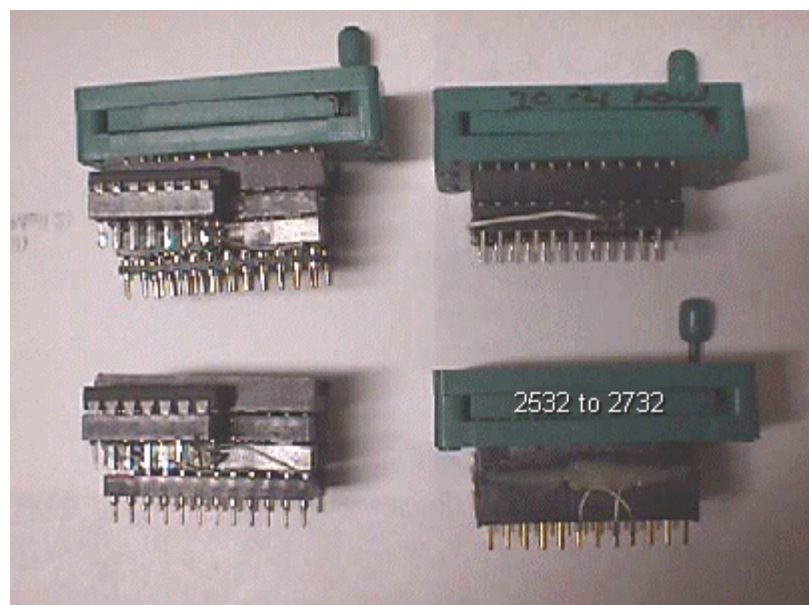
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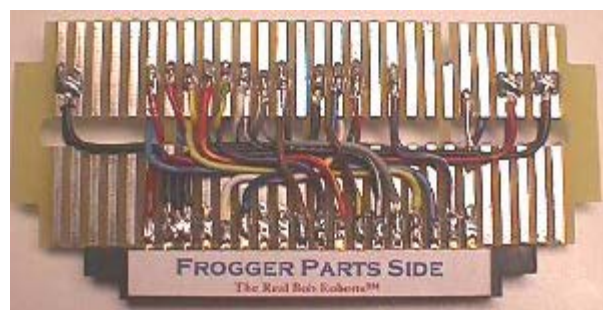


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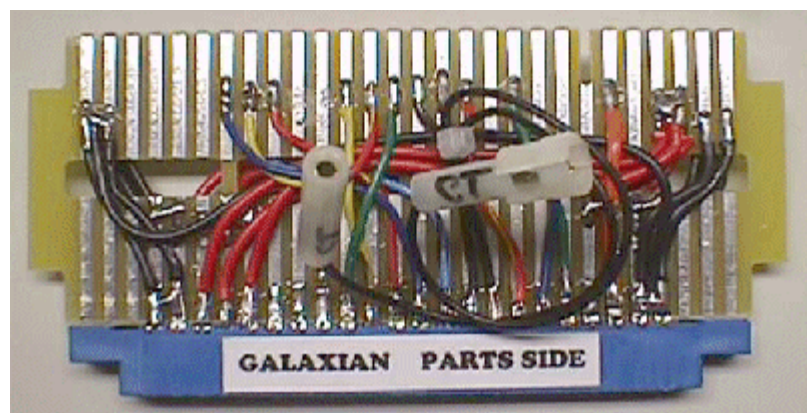


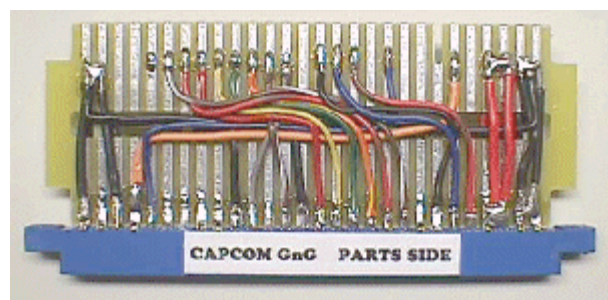


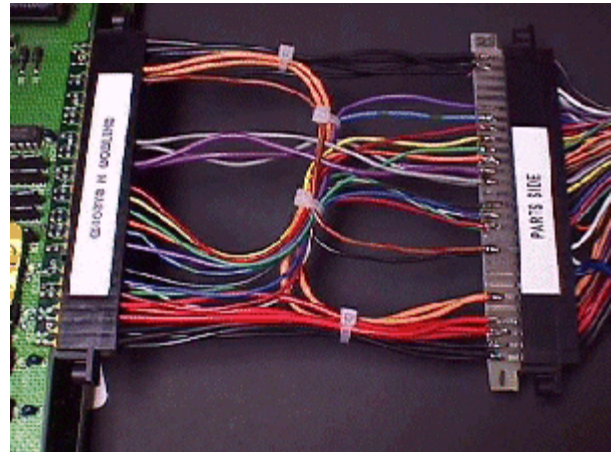


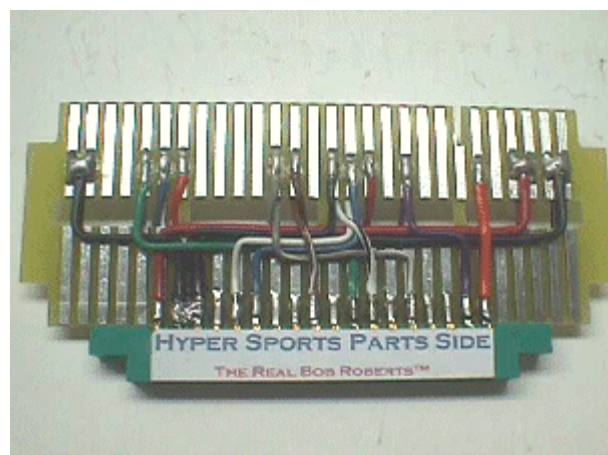




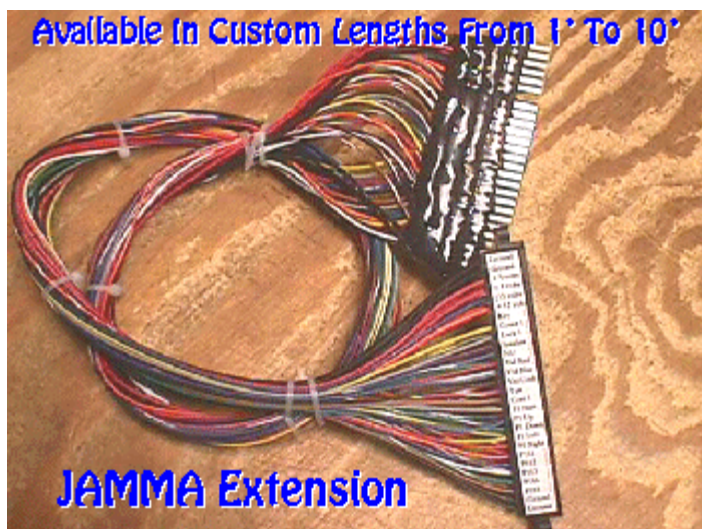






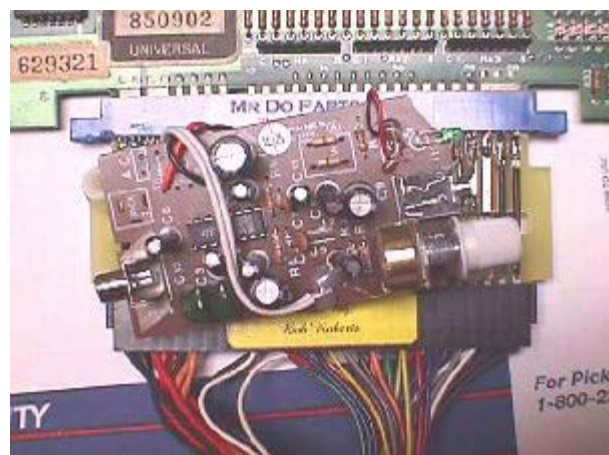


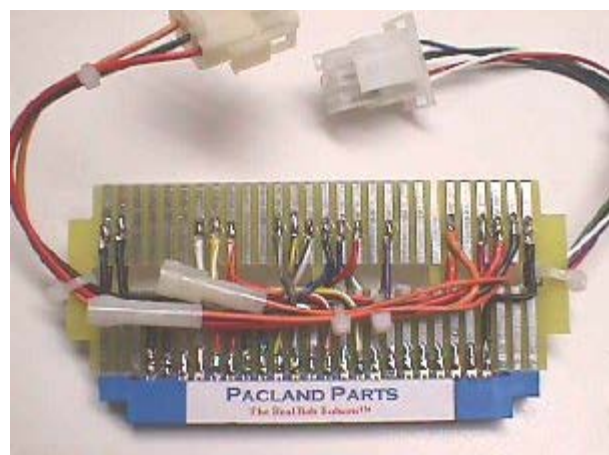


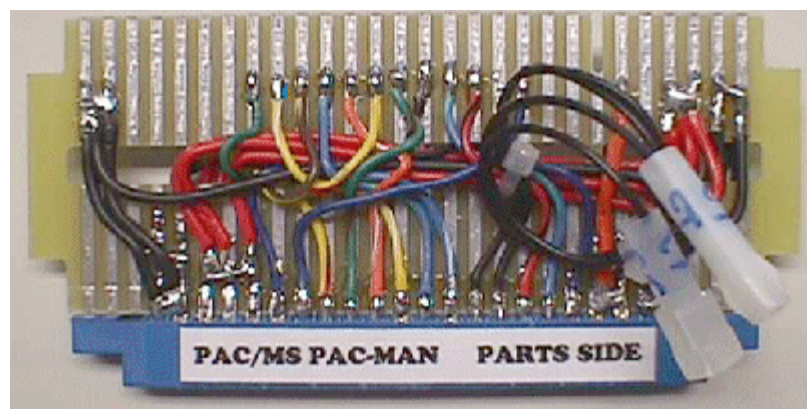






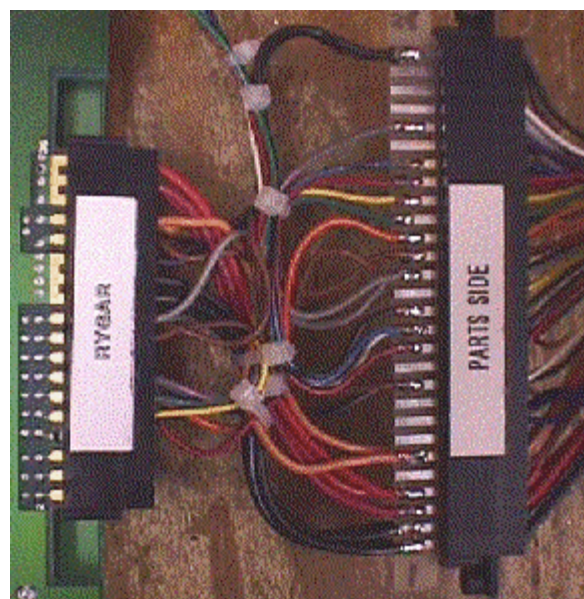




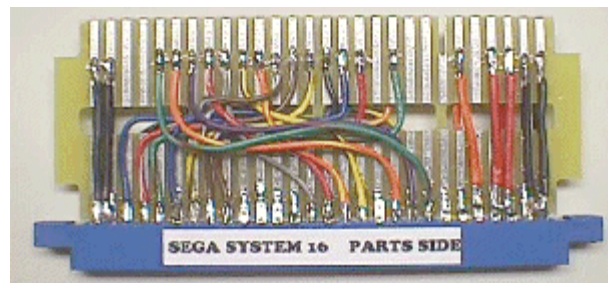


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A custom-made ribbon cable for the Rygar Game Boy cartridge. The cable is mounted on a green header labeled "RYGAR PARTS SIDE". It features a circular loop of red and blue wires, which are connected to the cartridge's pins. The cable is shown against a wooden background.







G05-802 or V2000 Monitor To G05-801 Cabinet

Connect To
G05-802/5
or V2000
Monitor

Connect To
G05-801
Cabinet
Wiring
Harness





This Page Has Moved To A New Home [Here.](#)

[What's My Monitor](#) Big Bear's Bulletin Board [Back to Parts Page](#)







\$2.50 ea



3A - 5A - 10A









Spare Fuse Holder & Insertion & Extraction Tool

I keep wishing that I had this spare fuse holder set up back in the day when we were pumping out 25 to 30 new games per week. I would have put one in every new cab & any cabs that came in for repairs. I can't even guess at how many hundreds of games passed thru the shop loaded down with creative fuses that usually had smoked the game bad enough for the op to bring the whole thing in. Gum & cigarette foils wrapped around the old blown fuse had to be the leader, then foil wrappings from other vended products, bolts, bent nails, antenna sections, bare wire wrappings & just about any other metal objects that would complete the circuit right down to sacrificing their favorite screwdriver.



If only they had one of these spare fuse holders mounted in the cab they would have had what they needed on hand ready to pop in. These things could mount to the cab side wall, back door, under the monitor shelf or any number places to insure that the correct fuse would be there when needed. Being labeled makes it possible to know exactly which fuse you need, e.g., if you had one mounted in an Atari cab with the full compliment of spare fuses in the assigned slots & you found F3 to be blown on the power block, it would be a simple matter to pull the F3 spare from the holder & change it out. Of course, making note to replace the one used from the holder at your convenience would make good sense, also. If you had one mounted in a cab that only used 3 or 4 fuses then you could double up on your spares... two sets or even three, so long as you relabeled the extras.

Another thing that I heard repeatedly from ops was that they had broken fuses when attempting to pull them out with a screwdriver, or other object, to test them ... many times saying that they were good until they broke the glass. That's when I would introduce them to the tool to extract them or insert them.



Having gained this knowledge through the vast amounts of games coming thru the shop I jumped at the chance to buy in these items thinking that it would be a good thing even for the hobbyist with only a few games. We have fuse sets for a few games & I may even be able to talk Alice into adding a few more common ones to make it easier to stock the spare holder.



Want to make sure the tool is there when you need it without sending out a search party.... maybe clipping right to one of the fuses in the cab might be a suitable answer.

This spare fuse holder kit consists of the labeled holder, mounting screws & the insertion/extraction tool for \$4.00. Fuse kits to fill it are sold separately... no fuses come with the kit.

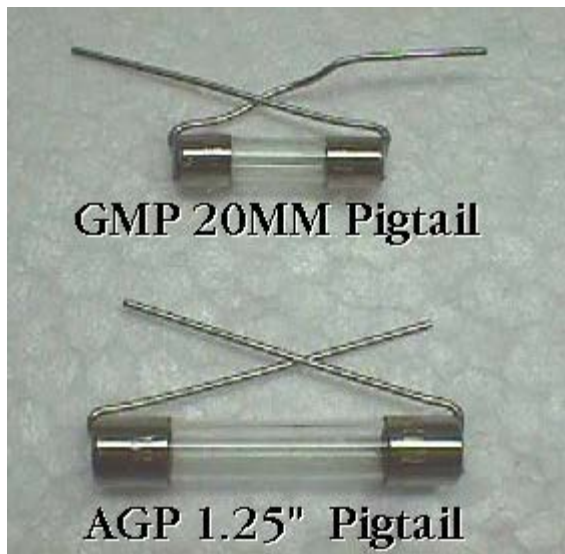
Happy Gaming...











Blown Fuses

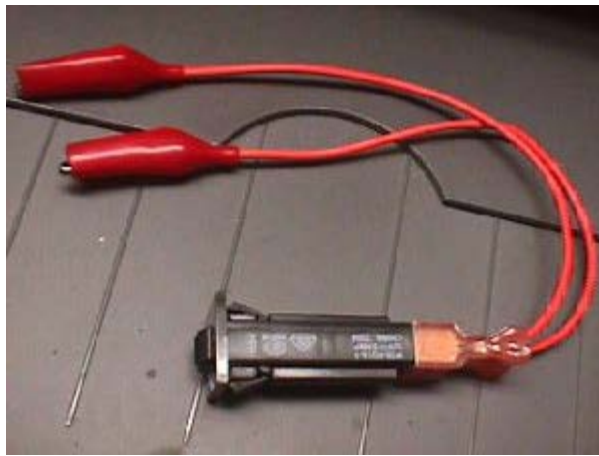
by Bob Roberts

I have heard this countless times & continue to hear it almost daily, paraphrased... "I've used a whole box of fuses & they just keep blowing right away." That's what they are suppose to do. They are there for over-current protection & if one blows out it is because there is a short of some kind that you have to correct before replacing the fuse. I'm guessing this comes from the old type household line fuses that would blow when you overloaded them... plugging in an iron, air conditioner or other appliance & as soon as you unplugged it & replaced the fuse in the fuse box you were good to go again. Well... these protective devices in coin-op work similarly, but instead of unplugging your appliance that you overloaded with, you have to hunt down the exact component that shorted & overloaded your circuit enough to blow the fuse & replace it before replacing the fuse.

After pointing this out quite often I'll hear that the person had thought they found the cause, replaced it & the fuse only to have it blow again. Now back in the day I use to have ops say they took a shortcut & repaired various things... one I always hesitate to mention because it is not only detrimental to your equipment, it very well may be dangerous to your well being... in any event, the shortcut they would take would be to put a bolt or other metal object in the holder with the machine unplugged, step back & plug it in & watch the fireworks. Whatever blew up was the shorted component & after replacing it & the fuse they were good to go. These were the lucky times when things worked out well for them & caused them to continue taking chances with explosive components, flying pieces and possibly igniting a fire. It usually only took one time when they demolished the piece of equipment that they were working on or caused sufficient extra damage to have to send it to the shop for a huge repair bill, for them to quit the shortcut business.

Of course, some routinely took shortcuts no matter the cost or consequence. Many would do the same thing using alligator clipped jumpers many times watching them melt & burn open before any explosion could take place.

This is NOT the way to handle a blown fuse problem! If you have a fuse that is blown then you have a problem in the circuit that the fuse is protecting & you **MUST** locate & repair the cause. In the shop this was always an easy task with all the proper equipment on hand, but on service calls many times we were able to effect a repair in the field without the equipment & without a pocketful of fuses by using a simple circuit breaker. This seems like it may be the answer for hobbyist working in a home environment, also. From what I've heard, I know it would save many a fuse & a bundle of money, at the very least.



This all prompted me to order in enough stuff to have my harness maker make up a few of these circuit testers using a circuit breaker. If you think you've corrected your problem & want to check it you simply clip the circuit breaker onto the fuse holder in place of the fuse. If your short is still there it will pop the circuit breaker when you power up & you can go back to the drawing board. A simple push on the circuit breaker button will reset it awaiting your next test. If your short is gone & your circuit breaker held for at least a few minutes then you're able to replace the fuse at that time.

Unfortunately, we used up the few hundred circuit breakers we bought in & they wanted more than double for more, so we had to go with a different style to keep the price reasonable.

This circuit breaker tester can be found on the Parts Page under the [Fuses](#) heading.

Happy Gaming...

[Site Index](#) - [Big Bear's Bulletin Board](#) - [Parts Page](#)

WG K7000 Series Repair Kit

1 Flyback Transformer

1 Cap Kit

1 HOT (2SD1398)

1 Fuse F1- 1.5ASB

wc3.jpg %d×%d pixels



K7000 Regulators

by Bob Roberts

The Wells-Gardner K7000 series chassis' used several different regulators in position IC4, so it is necessary for you to physically look at the regulator used on your particular chassis to insure you get the correct one. A general ROT is that the 19" chassis used the STR3123 or STR30123 to regulate to 123 volts, but chassis' have always been swapped around by ops & others to keep a monitor going without regard to it's size. The general ROT for the larger CRTs regulation is the STR3130 or STR30130 at 130 volts. Because of their similar numbers many have ordered the wrong regulator for their chassis. You need to pay close attention when checking your chassis to keep from using shelf space & avoiding extra shipping costs.



The first reg in the pic above is representative of the regs used by WG in earlier K4xxx models... STR381 & STR383... & the others are the typical K7000 regulators. You can see that if you had the wrong one you would not be able to match it up to the pinout, although WG did have some chassis' silked to fit either type.



Happy Gaming...

[Site Index](#) - [Big Bear's Bulletin Board](#) - [Parts Page](#)













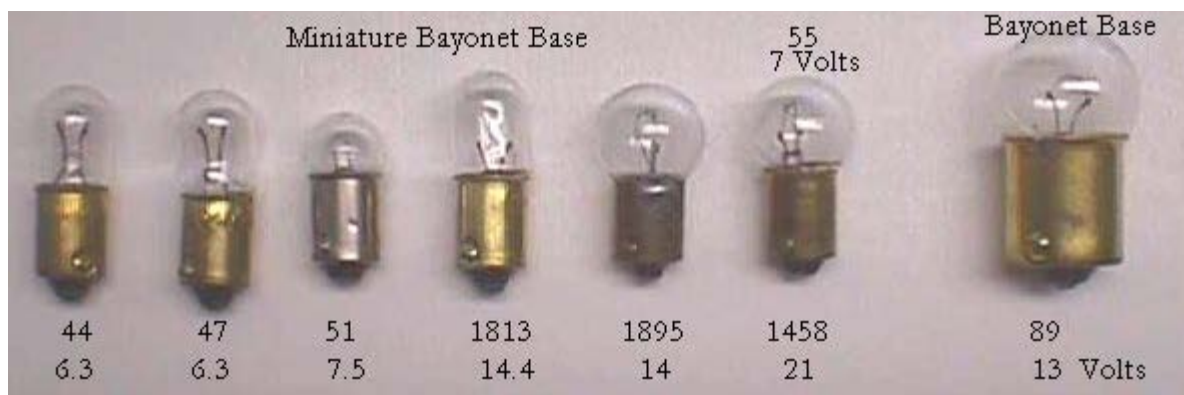
- Lamp Help -

By Bob Roberts

Newbies still have lots of trouble with the types of lamps used to light up coin windows & such, along with the voltage that is used to power them, so I'm going to move & combine different sections from my Help Pages into a single help doc linked to the lamp section of the Parts Page.

This is not a technical doc, but rather just a basic description of the common lamps used in coin-op. Many newbies want to know which lamp will last longer, what amps it will draw & so on. If you had a few hundred games on the street operating 24/7 I could possibly see the relevance of this, but as hobbyist I cannot see justification with a fifteen cent lamp that may last longer than the game in home use, although, I realize that some collectors own more games than operators do :-() In any event, the sole purpose of this is to help you ID a lamp type & voltage for your particular game.

First the bayonet type is a lamp with a smooth cylinder base that has two projecting pins which fit into slots on the holder & when twisted a quarter turn, lock themselves into the socket. Bayonet lamps would be #44 or #47 when used in a 5 to 6VDC or 6.3VAC circuit, and when powered by 12 volts you'd need a lamp such as the #1813.



The wedge type is as implied, a wedge lamp is pushed straight into the socket & has a chisel-shaped base, as opposed to, the cylindrical bayonet type. One loop of exposed wire to either side of the wedge base makes contact in the socket. Wedge lamps used in a 5 to 6VDC or 6.3VAC circuit would be #555 & in a 12 volt circuit you'd need #161 lamps.



As for voltage supplied in your particular cab, even if there are no lamps in it & you have no manual or schematics, you can always measure the voltage right across the two wires that feed the lamp... right at the socket. If you own a game you should have a meter, but on the off chance that you don't, any meter should do the trick, even a small pocket-sized \$5 analog meter from your local electronics store or I have them on the Parts Page if you're ordering other parts. If you

don't get a reading on DC swap over to AC because cabs are powered by both AC & DC voltages.

If you find your sockets are shot & you cannot find new like ones, but can find ones that are the same, but use a different based lamp, you can change over to them & select the appropriate lamp for your supply voltage.



One FAQ that seems unending is why are they called "lamps" instead of "bulbs". A bulb is defined by Webster's as, "1. any round, enlarged part, esp. at the end of a cylindrical object: the bulb of a thermometer 2. the round glass housing, in which a partial vacuum has been established, that contains the filament of an incandescent lamp". Household incandescent lamps of yesteryear were always in the shape of a bulb, hence earning the name of "light bulb", which has stuck even though we have a huge variety of household lamps today in every shape imaginable... they are still light bulbs. Our industry has called a lamp a lamp for as far back as I can remember & never adopted the term "bulb" and that may be because lamps that we use are not always in the shape of a bulb, rather than the loose meaning of a bulb being just a part of a lamp. Most people today have come to know the term "lamp" as only the thing that sits on either side of the sofa, but a lamp is any device that gives off artificial light.

[Lamps on the Parts Page](#)

Happy Gaming....







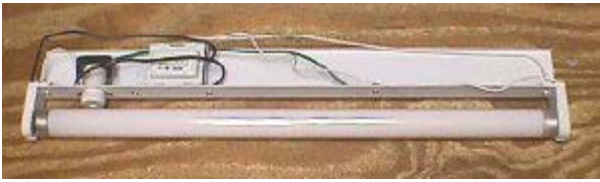
5 Volt Indicator Lamp
Positive Side Marked
.187 Connector Tabs
Snaps Into 1/2" Hole







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Most Popular 1/4 Watt Resistors
1
5.6
10
18
27
330
390
560
820
1k
1.2k
1.6k
3.3k
3.9k
4.7k
5.6k
6.8k
7.5k
10k
15k
39k
68k
100k
510k

Most Popular 1/2 Watt Resistors
1
2.7
3.3
3.9
5.6
6.8
10
15
39
68
47
75
120
240
390
470
560
680
1k
1.2k
1.5k
1.6k
2.2k
2.7k
6.8k
10k
12k
33k
39k
47k
68k
75k
100k
270k
470k

Most Popular 1 Watt Resistors
.39
.47
1.2
2
2.2
2.7
22
24
30
33
47
51
68
100
120
150
220
330
470
510
1k
1.5k
1.8k
2k
2.2k
2.7k
3.3k
4.7k
10k
30k
39k
47k
68k
100k
120k
150k
220k
240k



Most Popular 2 Watt Resistors
1.8Ω
22Ω
51Ω
68Ω
100Ω
270Ω
1k
1.2k
4.7k
5.6k
6.8k
22k
47k
62k
82k
100k
120k
150k
180k
200k
220k
240k
300k
390k
430k
470k
510k
560k
750k
820k
1M





7W2.7 Ohm Stand Up

G07 R902

K7000 R103

7W2.7ΩJ



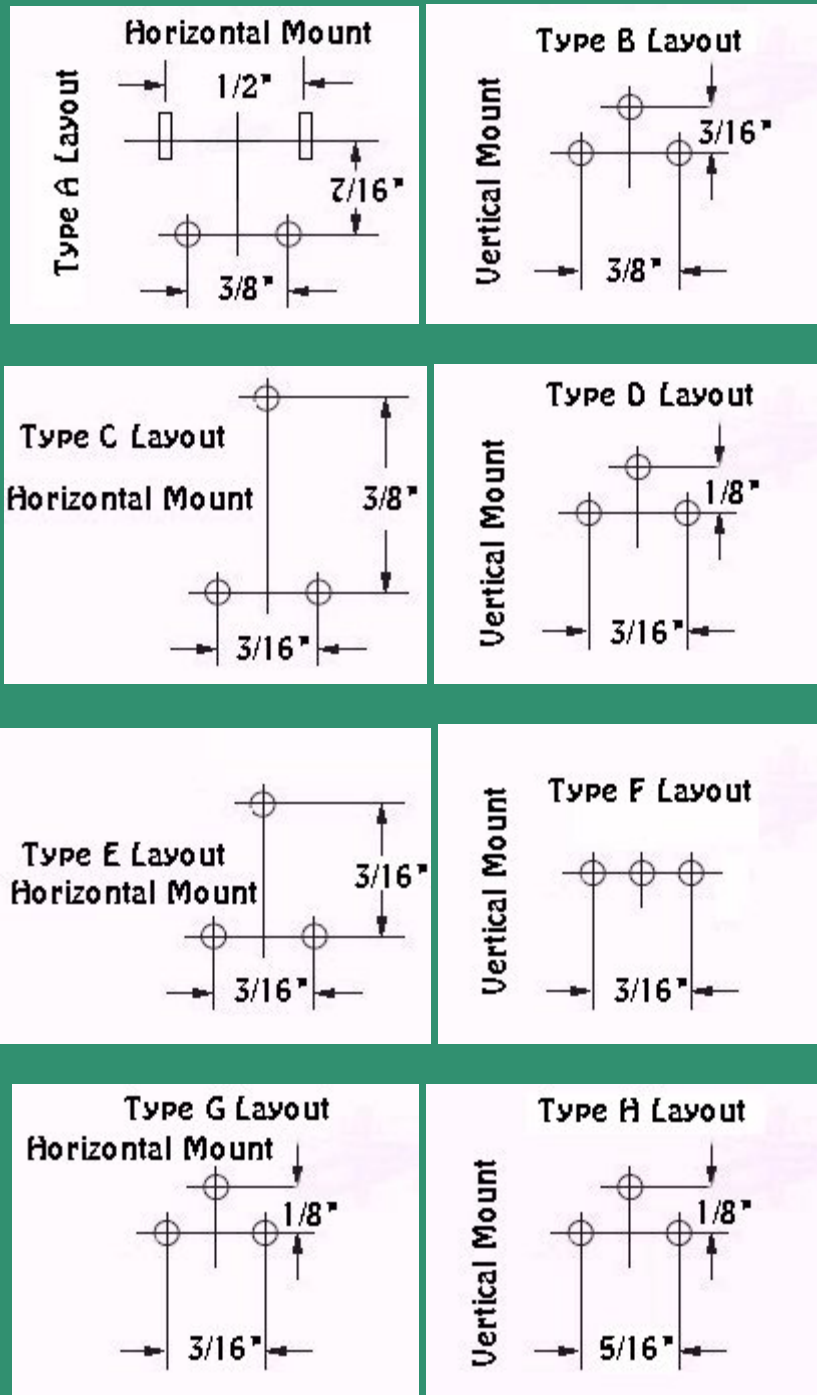






Pot Page








Pot Layout Types

















Most times a pot is not going to look exactly like a pot made back in the 70s/80s/90s or maybe even last year, and looks vary by mfr, so having the footprints above should help you ID a pot that will work in your particular app. I have thousands of pots here & I figured it was time to make a list of them so that we would all know what I have available.











Chances are that you'll be able to find something that will work for you below. Use the part number in the first column to order, so that you get the exact one you're looking for.

P1002		Type A	250	\$1.00
P1003		Type A	500	\$1.00
P1004		Type A	2.5K	\$1.00
P1005		Type A	5K	\$1.00
P1006		Type A	10K	\$1.00
P1007		Type A	25K	\$1.00
P1008		Type A	50K	\$1.00
P1009		Type A	100K	\$1.00

					
P1010		Type A	500K	\$1.00	
P1011		Type A	5Meg	\$1.00	
P1012		Type B	100	\$1.00	
P1013		Type B	200	\$1.00	
P1014		Type B	250	\$1.00	
P1015		Type B	500	\$1.00	
P1016		Type B	2K	\$1.00	










					
P1017		Type B	2.5K	\$2.50	
P1018		Type B	2.5K	\$1.00	
P1019		Type B	5K	\$1.00	
P1020		Type B	10K	\$1.00	
P1021		Type B	10K	\$1.00	
P1022		Type B	25K	\$1.00	
P1023		Type B	25K	\$1.00	









					
P1024		Type B	25K	\$1.00	
P1025		Type B	50K	\$1.00	
P1026		Type B	100K	\$1.00	
P1027		Type B	500K	\$1.00	
P1028		Type C	100	\$2.00	
P1029		Type C	200	\$2.00	
P1030		Type C	500	\$2.00	









				
P1031		Type C	1K	\$2.00
P1032		Type C	2K	\$2.00
P1033		Type C	5K	\$2.00
P1034		Type C	10K	\$2.00
P1035		Type C	20K	\$2.00
P1036		Type C	50K	\$2.00
P1037		Type C	100K	\$2.00
P1038		Type C	500K	\$2.00
P1039		Type C	200	\$2.00










P1040		Type C	500	\$2.00
P1041		Type C	1K	\$2.00
P1042		Type C	2K	Gone
P1043		Type C	5K	\$2.00
P1044		Type C	20K	\$2.00
P1045		Type C	50K	\$2.00
P1046		Type C	100K	\$2.00
P1047		Type C	100	\$2.00
P1048		Type C	2K	\$2.00
P1049		Type C	250K	\$2.00












P1050		Type C	1K	\$1.50
P1051		Type C	5K	Gone
P1052		Type C	25K	\$1.50
P1053		Type C	250K	\$1.50
P1054		Type C	500K	\$1.50
P1055		Type C	200	\$1.50
P1056		Type C	500	\$1.50
P1057		Type C	2K	\$1.50
P1058		Type C	10K	\$1.50
P1059		Type C	20K	\$1.50
P1060		Type C	200K	\$1.50











					
P1061		Type C	500K	\$1.50	
P1062		Type C	2.5K	\$1.00	
P1063		Type C	100K	\$1.00	
P1064		Type C	1K	\$1.00	
P1065		Type C	2K	\$1.00	
P1066		Type C	5K	Gone	
P1067		Type C	10K	\$1.00	
P1068		Type C	500K	\$1.00	
P1219		Type D	100	\$2.00	










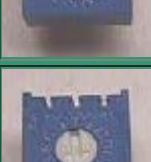

					
P1069		Type D	200	Gone	
P1070		Type D	500	Gone	
P1071		Type D	1K	\$2.00	
P1072		Type D	5K	Gone	
P1220		Type D	10K	\$2.00	
P1073		Type D	20K	Gone	
P1074		Type D	50K	\$2.00	






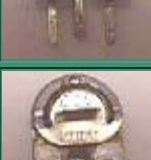




	P1075		Type D	100K	\$2.00	
	P1076		Type D	500K	\$2.00	
	P1077		Type D	2K	\$1.00	
	P1078		Type D	50K	\$1.00	
	P1079		Type D	100K	\$1.00	
	P1080		Type D	200K	\$3.00	
	P1081		Type D	1.5K	\$1.00	
	P1082		Type D	5K	\$1.00	










P1083		Type D	10K	\$1.00
P1084		Type D	20K	\$1.00
P1085		Type D	20K	\$1.00
P1086		Type D	200	\$1.00
P1087		Type D	5K	\$1.00
P1088		Type D	50K	\$1.00
P1089		Type E	100	\$1.00
P1090		Type E	200	\$1.00
P1091		Type E	500	\$1.00
P1092		Type E	2K	\$1.00

					
P1093		Type E	5K	\$1.00	
P1094		Type E	10K	\$1.00	
P1095		Type E	20K	\$1.00	
P1096		Type E	50K	\$1.00	
P1097		Type E	100K	\$1.00	
P1098		Type E	200K	\$1.00	
P1099		Type E	500K	\$1.00	
P1100		Type E	5K	\$1.00	
P1101		Type E	5K	\$1.00	
P1102		Type E	10K	\$1.00	

P1103		Type E	20K	\$1.00
P1104		Type E	100K	\$1.00
P1105		Type E	200K	\$1.00
P1106		Type F	200	\$2.00
P1107		Type F	1K	\$2.00
P1108		Type F	2K	\$2.00
P1109		Type F	10K	\$2.00
P1110		Type FH	200	\$2.00
P1111		Type FH	2K	\$2.00
P1112		Type FH	10K	\$2.00
P1113		Type G	1K	\$2.00

				
P1114		Type G	10K	\$2.00
P1115		Type G	25K	\$2.00
P1116		Type G	500	\$1.00
P1117		Type G	1K	\$1.00
P1118		Type G	5K	\$1.00
P1119		Type G	10K	\$1.00
P1120		Type G	50K	\$1.00
P1121		Type G	100K	\$1.00
P1122		Type G	1M	\$1.00
P1123		Type G	470	\$1.00








	P1124		Type G	1K	\$1.00
	P1125		Type G	2K	\$1.00
	P1126		Type G	5K	\$1.00
	P1127		Type H	100	\$1.00
	P1128		Type H	500	\$1.00
	P1129		Type H	2K	\$1.00
	P1130		Type H	20K	\$1.00
	P1131		Type H	100K	\$1.00
	P1132		Type H	200K	\$1.00
	P1133		Type C	20K	\$2.00







	P1134		Type B	50K	\$2.00	
	P1135		Type A	100	\$1.00	
	P1136		Type A	500	\$1.00	
	P1137		Type A	25K	\$1.00	
	P1138		Type EV	500	\$3.00	
	P1139		Type EV	2K	\$3.00	
	P1140		Type EV	5K	\$3.00	
	P1141		Type EV	10K	\$3.00	
	P1142		Type EV	200K	\$3.00	








P1143		Type C	200	\$3.00
P1144		Type C	500	\$3.00
P1145		Type C	2K	\$3.00
P1146		Type C	10K	\$3.00
P1147		Type C	25K	\$3.00
P1148		Type B	2.5K	\$1.00
P1149		Type B	50K	\$1.00
P1150		Type D	10K	\$1.00

















P1151		Type F	1K	\$1.00
P1152		Type F	5K	\$1.00
P1153		Type F	10K	\$1.00
P1154		Type F	25K	\$1.00
P1155		Type C	1K	\$1.50
P1156		Type E	1K	\$1.00
P1157		Type F	50K	\$2.00
P1158		Type G	2K	\$1.00







					
P1159		Type G	20K	\$1.00	
P1160		Type B	500	\$2.50	
P1161		Type B	1K	\$2.50	
P1162		Type B	2.5K	\$2.50	
P1163		Type B	5K	\$2.50	
P1164		Type B	25K	\$2.50	








	P1165		Type B	30K	\$2.50	
	P1166		Type B	47K	\$2.50	
	P1167		Type B	50K	\$2.50	
	P1168		Type B	220K	\$2.50	
	P1169		Type B	500K	\$2.50	
	P1170		Type B	1 Meg	\$2.50	
	P1171		Type B	500	\$2.50	









					
P1172		Type B	1K	\$2.50	
P1173		Type B	2.5K	\$2.50	
P1174		Type B	5K	\$2.50	
P1175		Type B	25K	\$2.50	
P1176		Type B	30K	\$2.50	
P1177		Type B SI Volume	47K	\$2.50	
P1178		Type B	50K	\$2.50	

						
	P1179		Type B	220K	\$2.50	
	P1180		Type B	500K	\$2.50	
	P1181		Type B	1 Meg	\$2.50	
	P1182		Type E	500	\$1.00	
	P1183		Type E	1K	\$1.00	
	P1184		Type E	5K	\$1.00	
	P1185		Type E	10K	\$1.00	

				
P1186		Type E	20K	\$1.00
P1187		Type E	50K	\$1.00
P1188		Type E	100K	\$1.00
P1189		Type E	500K	\$1.00
P1190		Type B	4.7K	\$2.50
P1191		Type B	4.7K	\$2.50
P1192		Type B	500	\$1.00

					
P1193		Type D	100K	\$2.00	
P1194		Type C	100	\$2.00	
P1195		Type B	300	\$1.00	
P1196		Type B	1K	\$1.00	
P1197		Type B	3K	\$1.00	
P1198		Type B	5K	\$1.00	

					
P1199		Type B	10K	\$1.00	
P1200		Type B	30K	\$1.00	
P1201		Type B	300K	\$1.00	
P1202		Type C	25K	\$2.00	
P1203		Type C	200K	\$2.00	
P1204		Type A	1K	\$1.00	
P1205		Type D Green	500	\$1.00	

					
P1206		Type D Yellow	1K	\$1.00	
P1207		Type D Blue	5K	\$1.00	
P1208		Type D White	10K	\$1.00	
P1209		Type D Purple	250K	\$1.00	
P1210		Type C	10K	\$2.00	
P1211		Type C	500K	\$2.00	
P1212		Type D Red	2K	\$1.00	

P1213		Type D Orange	50K	\$1.00
P1214		Type C	5K	\$1.00
P1215		Type A	200	\$1.00
P1216		Type F	10K	\$1.00
P1217		Type F	500	\$1.00
P1218		Type F	100K	\$1.00

[E-mail](#) - [Rewind](#) - [Help Page](#) - [Ordering FAQ](#)
[Specials](#) - [Parts Page](#) - [Site Index](#)

ataripot.jpg %d×%d pixels





Pop cap off & loosen screw, slip onto pot shaft
and tighten... replace cap... job done!



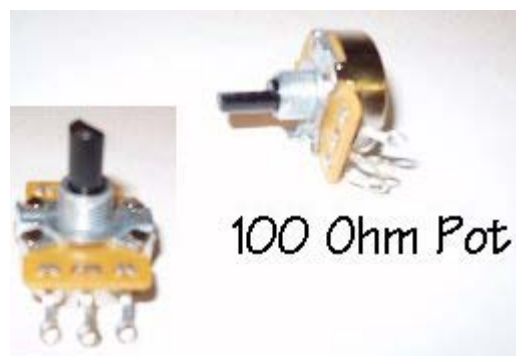
Knob only!! Pot available at \$25.00







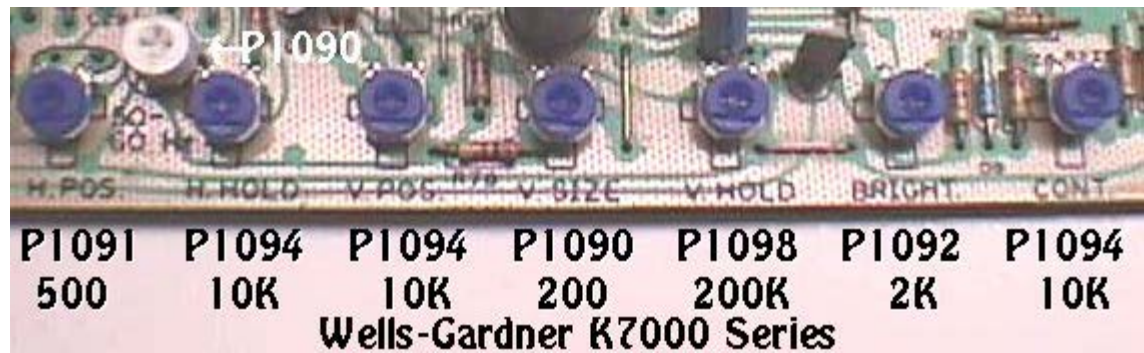
10K Sealed Pot



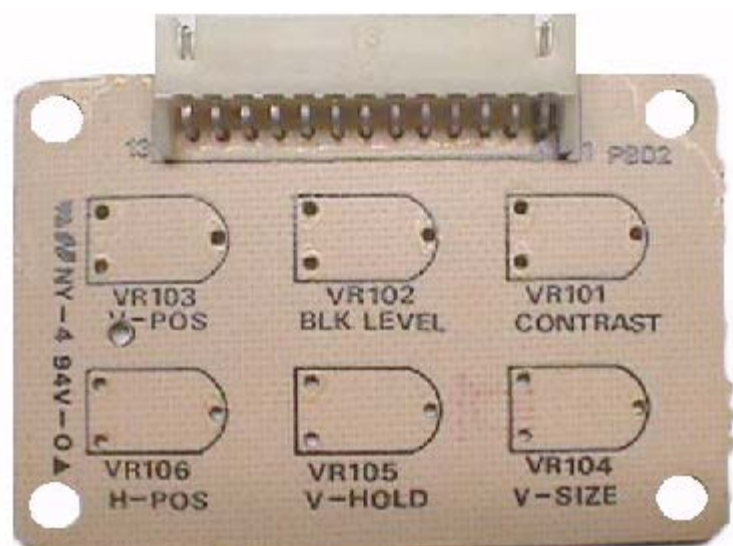
wmspot.jpg %d×%d pixels



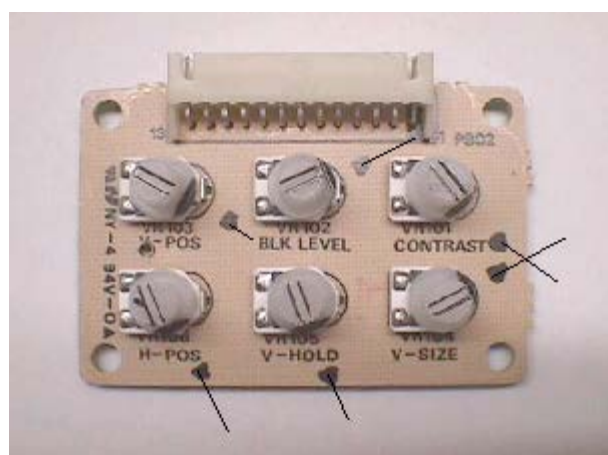




The K7000 Remote Pot Kit contains the 6 horizontal mount pots used on the remote bd as pic'd below.



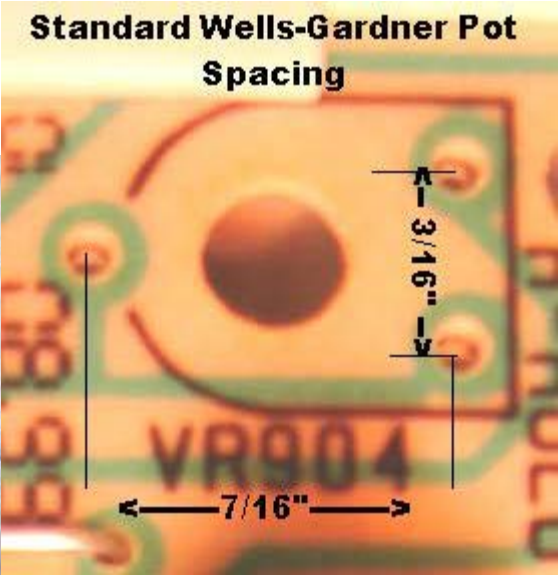
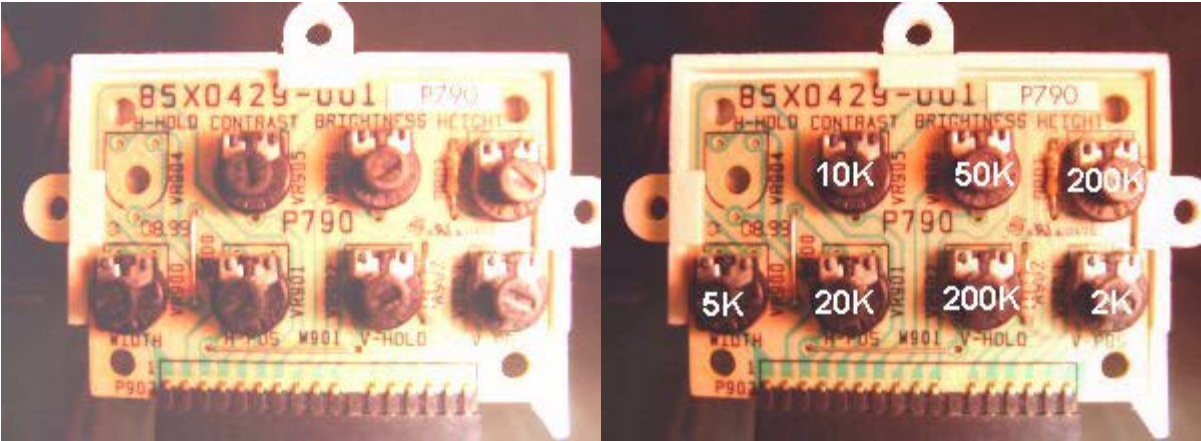
The kit comes with instructions so that you know what pot goes where :-). The pic below shows a start position for each pot and can also serve as a starting point on a used remote bd to get each one in range, cutting down on the guess work & numerous adjusts back and forth looking for the ideal setup.



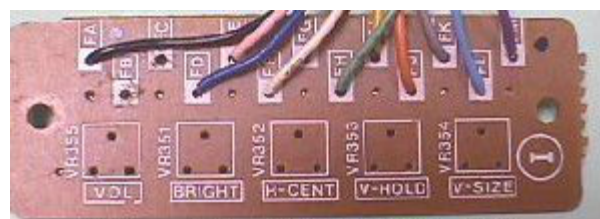
I've used a black marker on the adjustment slots to highlight them & also marked the flat end that serves as the direction indicator. I put a corresponding black mark on the bd itself along with a direction line. Most chassis' will have at least 4 of the pots in this approximate position with the balance being off slightly in either direction depending of the age & wear of the chassis' components.

There are several value variations on these pots from remote to remote bd depending on which series it was mfg'd to accompany, but the range of values works with any of the chassis models making them universal among the K7000 series. I would assume this to be true in the new K7400 series, as well, but I don't have one to compare it to, so you may want to measure the pot values on a K7400 series before attempting to use a K7000 series remote bd or at least compare values in the manuals of both.

From time to time I do come by a few used K7000 remote bds & have them for sale at \$20 each scope tested, repaired if necessary and adjusted with a 24-hour burn-in period. Only minor fine tuning should be needed upon installation... again, depending on age & wear of your chassis' components.







50K 10K 100K 200K 50K

If pot is unmarked then it uses color code.

Orange Cream Gray Purple Orange





Better Nintendo Replacement Pots
In Both 30K & 50K Sizes



30K P1165 \$2.50 Each or \$4.00 Per Pair
50K P1167 \$2.50 Each or \$4.00 Per Pair
The Real Bob Roberts™



10 Foot Nintendo AC Power Cord









midwayadj.jpg %d×%d pixels



**Multi-Value Can Filter Caps
Used In B&W Monitors**

Can 1

1000uf 35wvdc
500uf 35wvdc
500uf 35wvdc

Can 2

40uf 450wvdc
20uf 450wvdc
20uf 450wvdc
20uf 450wvdc

Can 3

60uf 350wvdc
20uf 350wvdc
20uf 250wvdc
10uf 150wvdc

Can 4

300uf 175wvdc
300uf 150wvdc
200uf 50wvdc
30uf 150wvdc

**These were originally priced from \$15.00
to \$30.00 each & are now clearanced at
\$12.50 each.**

Bally/Stern Solenoid Board

Replacing The 190VDC Regulator Filter

by Bob Roberts



Just another quick example of replacing one of the old obsolete high value axial capacitors using C26 on the Bally solenoid board. Original axial was 160uf350v & a 150uf to 200uf modern snap in cap at a voltage rating of at least 350VDC will work just fine.



Just add wires & you have your leads... red for positive (+) & black for negative (-). Depending on how you choose to mount yours you can use proper lengths of wire & not the exaggerated ones I have for demonstration purposes above.



One way you can mount the cap is on end using a hot glue gun with the leads pointing away from the board. While your glue gun is out you can even put a daub on the plus terminal to eliminate a potential shock situation while poking around in backbox.

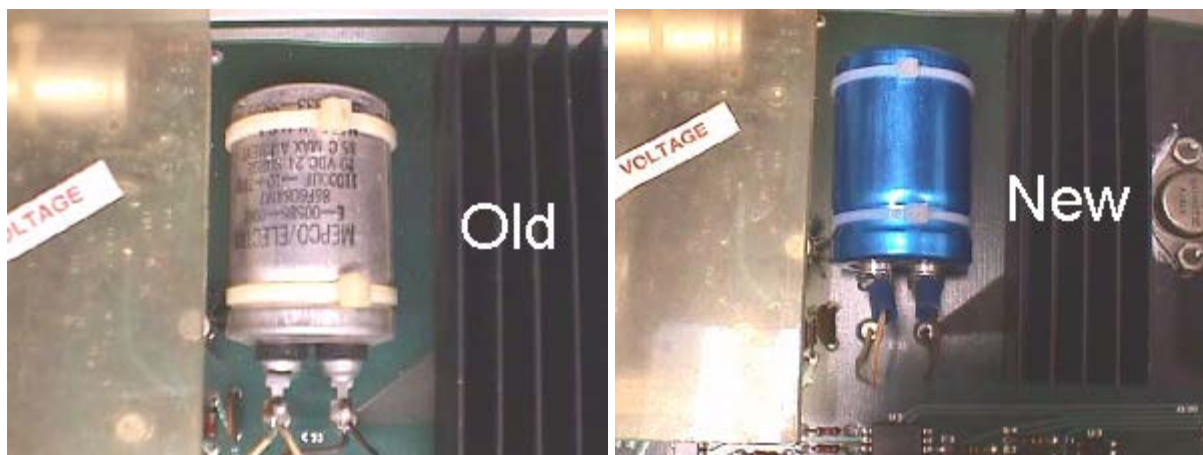


Another way to mount it is to just use Pac-Man bd sized cable ties & mount it right back on the board where the original was... again... with proper length wires for a neat job & not exaggerated excesses of wire bulging out.

Happy Gaming...



I've had so many requests for a 12,000uf 25v cap that I have decided to have some made. They are in production now & should be ready to ship by the end of January.



The dimensions are 2" long by 1 3/8" in diameter & the new one will have a black PVC sleeve, as opposed to the blue pic'd above.



16,000uf 15v CG Cap





Midway "Suitcase" Power Supply
Filter Capacitor

Here's another item so requested that I decided that I'd go ahead & have them made. It's been a long lead time, but there are now 9 cases of them taking up residence in Alice's hallway while waiting for new homes. A lot of the Midway games had these filters in the big silver box located in the cab bottom & most often referred to as the "suitcase" power supply.... weighs a lot more than any suitcase I've ever packed, though :-() They can be used to replace the Taito power supply filter (51,000uf 25v), Gottlieb filters (50,000uf 25v) and were also used in other games, with values from 49,000uf to 60,000uf 25v for filtering the DC power.

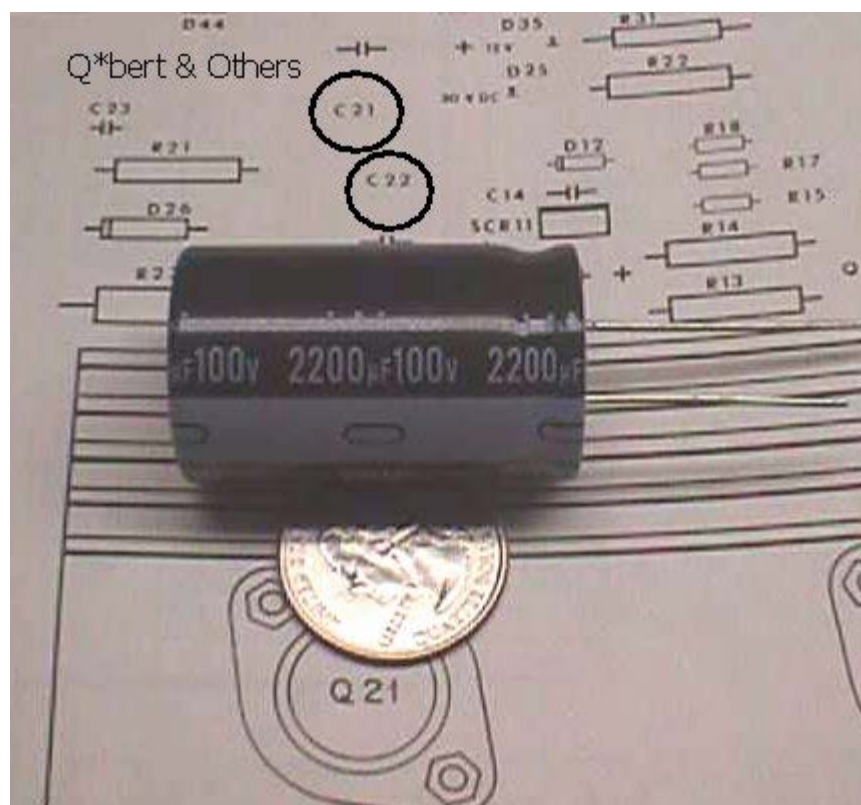


Midway "Suitcase" Power Supply Filter Capacitor Two - The Sequel

A lot of you have been asking me to have the 100,000uf 16v cap made up fresh because you don't like paying \$20 for a surplus cap that may have less life left in it than the cap you already have & you can't see your way clear to paying \$42 for a new one :-). Well... I held off having them made for a long time thinking that someone else might take the big plunge, but at the beginning of the year when no one had, I went ahead with the project & they are now here ready to ship... fresh 100,000uf 16v computer grade caps in a 2 1/2" x 3" encasement.

These are used in the MCR transformer assemblies & in many other power supply applications of yesteryear.







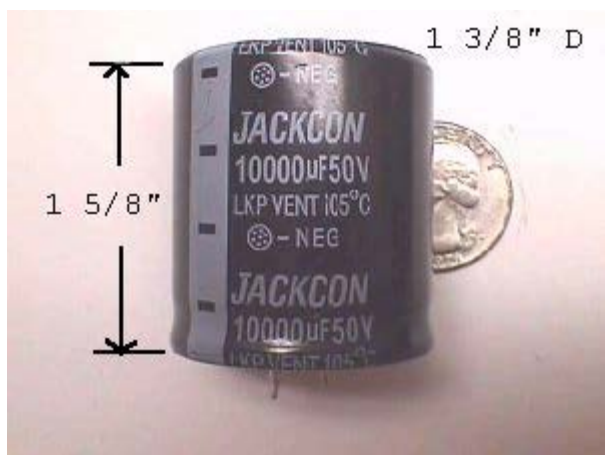




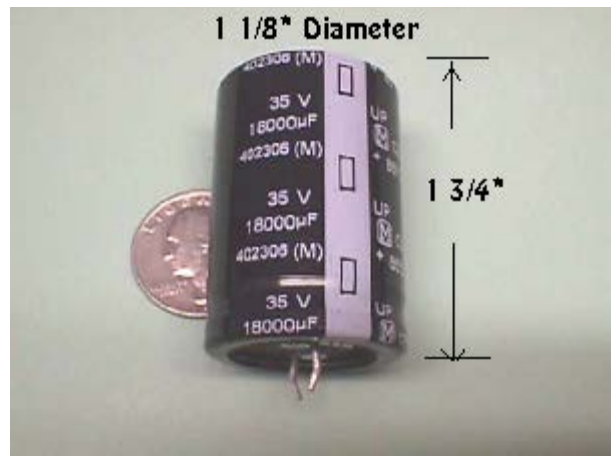
6800-50.jpg %d×%d pixels



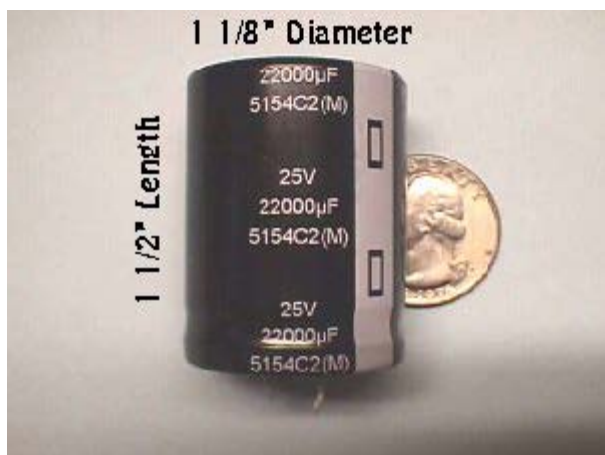


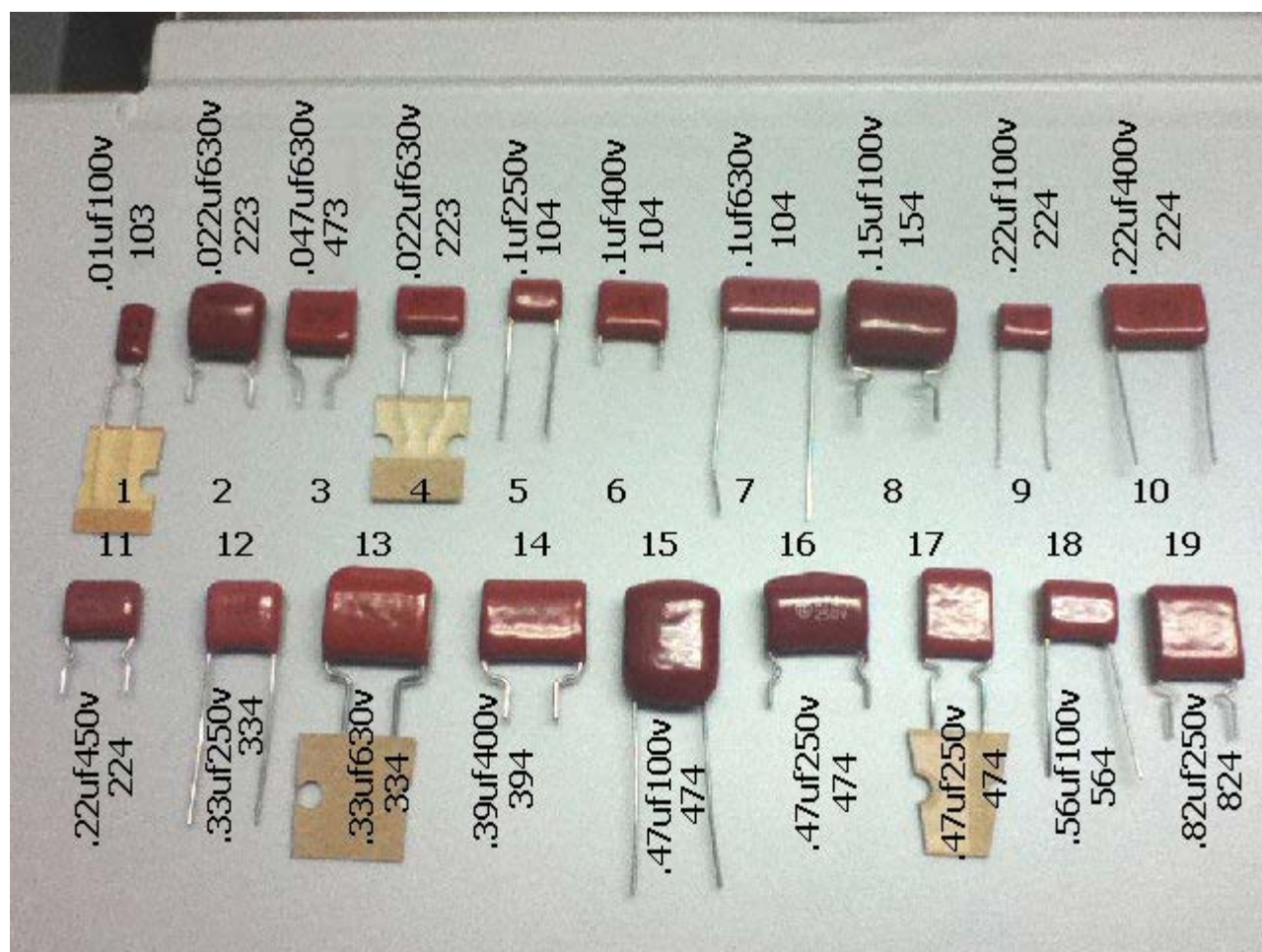












Ceramic Disc Capacitors

10PF 50V
22PF 50V
39PF 50V
47PF 50V
68PF 50V
100PF 50V
220PF 50V
330PF 50V
470PF 50V
470PF 1KV
820PF 1KV
3300PF 1KV (.0033UF)

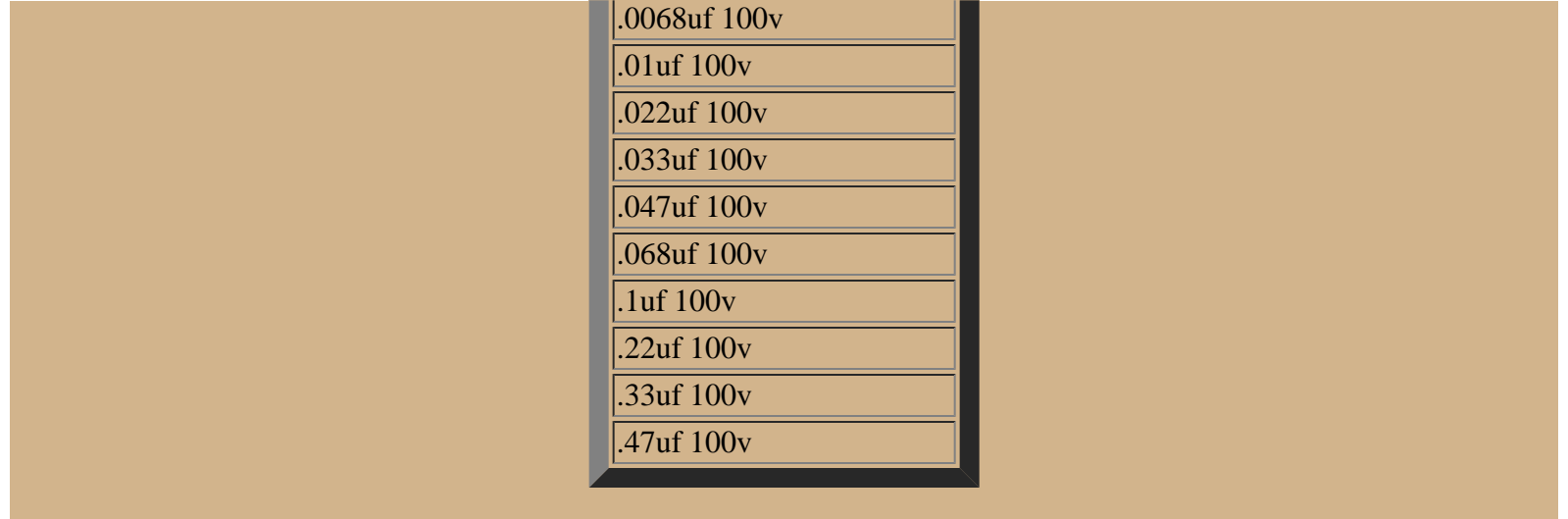
1NF 50V
2.2NF 50V
4.7NF 50V
10NF 50V
22NF 50V
47NF 50V
100NF 50V
220NF 50V
.01UF 50V
.01UF 100V
.022UF 50V
.033UF 50V
.047UF 50V

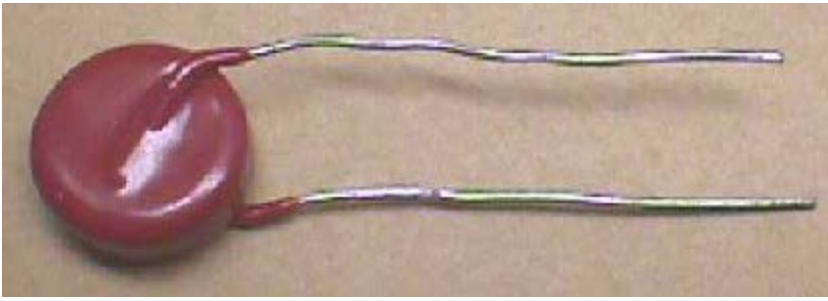
Axial Ceramic Caps

820PF 50V
.01UF 50V
.056UF 50V
.1UF 50V
.22UF 50V

Mylar Caps

.001uf 100v
.0015uf 100v
.0022uf 100v
.0033uf 100v
.0047uf 100v
.0056uf 100v

















cap15v200.jpg %d×%d pixels





cap47v25.jpg %d x %d pixels





Updated 1/21/2015

Frequency (MHz)	Type
2.000	1
3.579545	1
3.579545 (\$4.00)	2
4.000	1
10.000	1
12.096	1
14.3181	1
14.7456	1
16.000	1
18.000	1
18.432	1
24.576	1
Clock Oscillator	Type
1.000	3
1.8432	3
2.000	3
2.4576	3
3.6864	3
4.000	3
6.000	3
7.3728	3
8.000	3
9.8304	3
10.000	3
12.000	3
16.000	3
20.000	3
21.5827	3
24.000	3

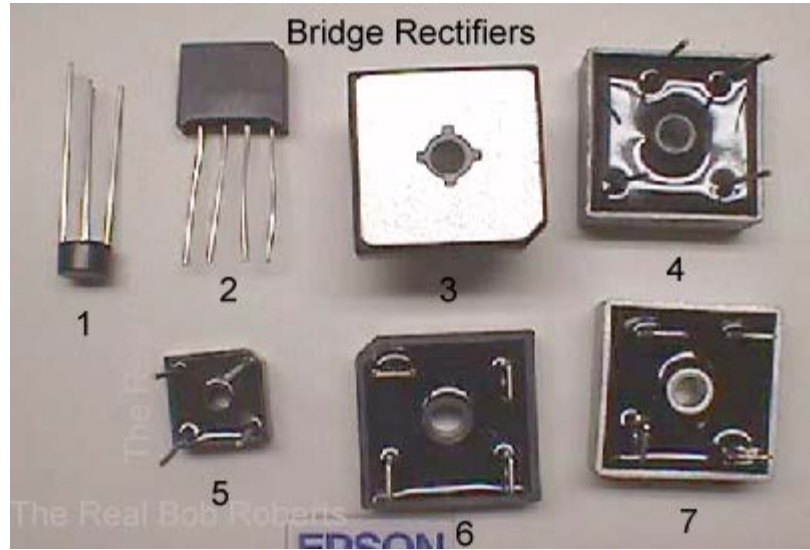
25.175	3
30.000	3
32.500	3
36.000	3
36.3636	3
40.000	3
44.600	3











**Large Mica Insulators
For Transistors Like 2SD1398
Transistor Not Included**

Use With:

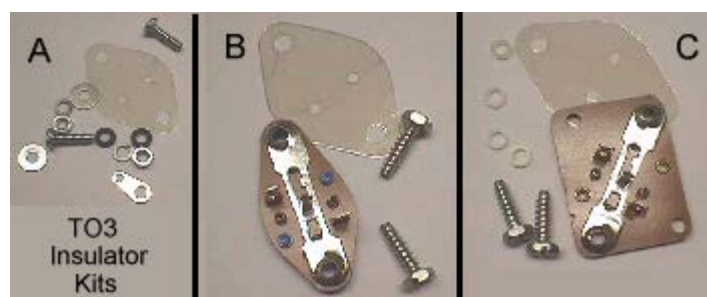
- BU2532AL
- 2SC3686
- 2SC3687
- 2SC3688
- 2SC2555
- BU508A
- 2SD1090
- Many
- Others



2/\$1.00













1106.jpg %d×%d pixels



1398.jpg %d x %d pixels











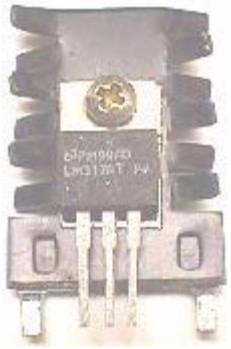
4000 - 4500 - 74LS Series ICs
4006
4011
4015
4016
4017
4024
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4066
4068
4069
4078
4081
4093
4502
4517 Shift Register
4526
4528
7400
7401
7402
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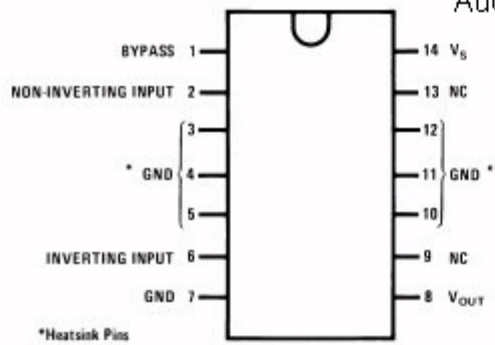
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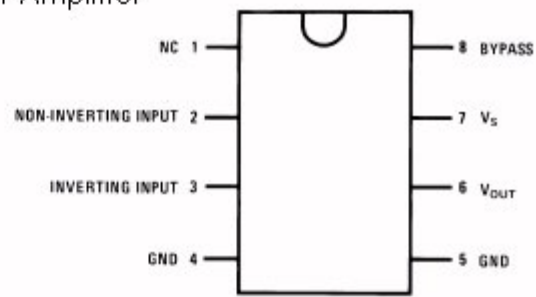
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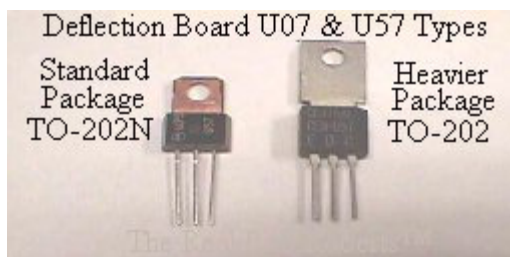
Audio Power Amplifier



LM380N 14 Pin



LM380N-8 8 Pin



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tda1675.jpg %d×%d pixels



amp40.jpg %d×%d pixels







BY THE TUBE

14PIN - \$17
16PIN - \$15
18PIN - \$12.50
24PIN - \$10
28PIN - \$8.50

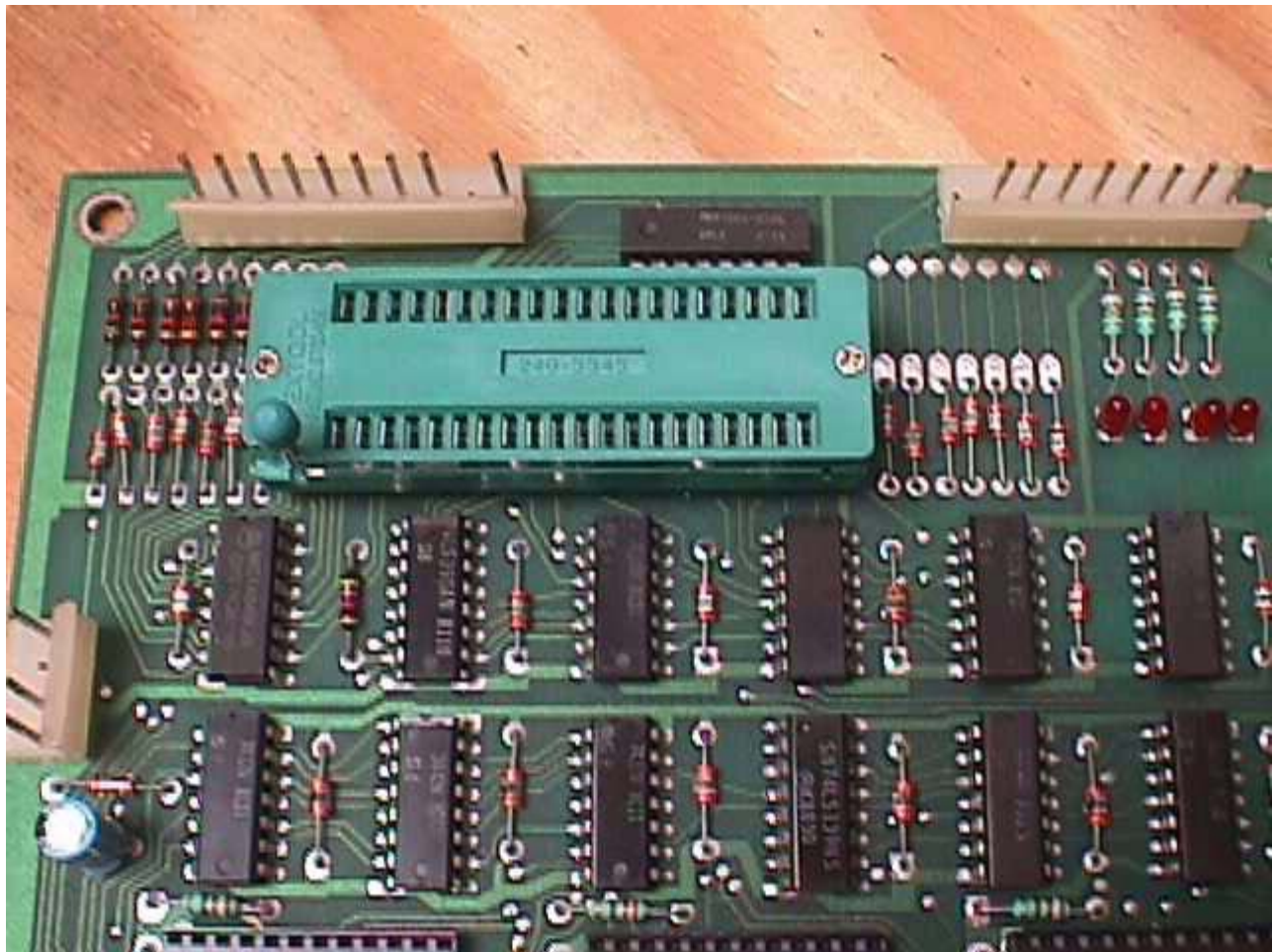


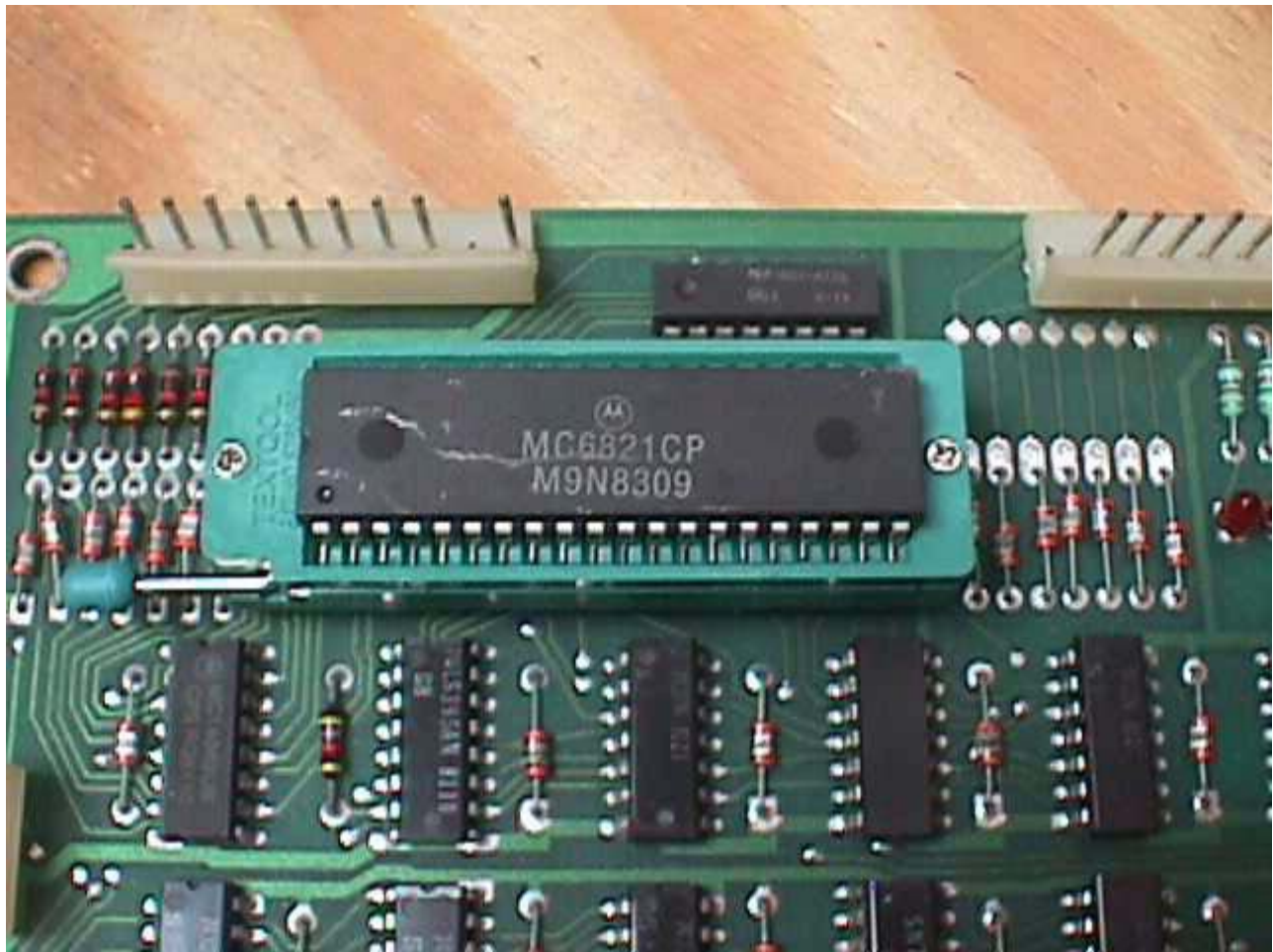
40 Pin Zif Sockets

by Bob Roberts

Here's another aid that comes in handy when you're working on PCBs or need to test a bunch of 40 pin ICs. We had game boards all set up with 24 pin, 28 pin & 40 pin ZIF sockets so that any chip that was questionable could actually be tested in circuit on a proven board.

A ZIF socket is a Zero Insertion Force IC socket. When the lever is in the up position the contacts inside are spread open, so that the IC will fall in loosely.... hence zero insertion force. Once your IC is in place you simply turn the lever down to the horizontal position to push all contacts closed, gripping the IC pins firmly. This allows for thousands of safe insertions & extractions. That's why you find them on eprom programmers.





Happy Gaming...

[Site Index](#) - [Big Bear's Bulletin Board](#) - [Parts Page](#)

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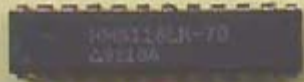
Standard vs Slimline 6116 Ram



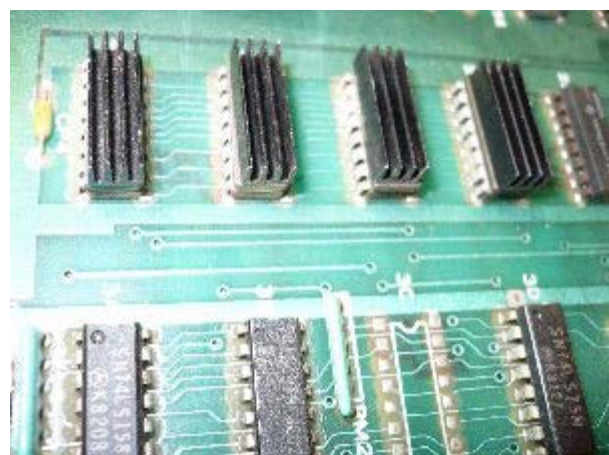
Z80A 40 Pin CPU



6116 Standard Size Ram .6 Wide



6116 Slimline Size Ram .3 Wide



2016 Cross Reference

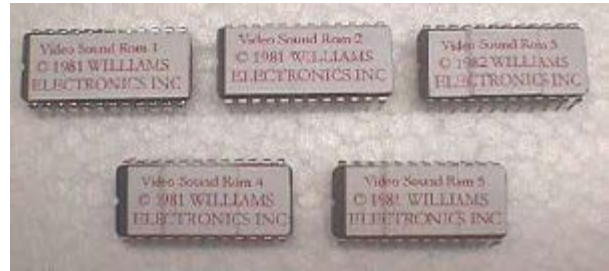
AM9128	CY6116	CY7C128	MB8128	uPD4016
CDM6116	HM6516	HM6116	HY6116	HN65728
M5M5116	M58275	M58725	M5M5117	M5M5118
MCM2016	MCM6116	MMC2116	MSM2128	MSM5128
LH5115	LH5116	BCM2116	SCM2116	STC6116
ET2128	MK2817	TC5516	TC5517	TC5518
TMM2015	TMM2018	V62V16	GM7628	IDT6166

[Back to Parts Page](#)

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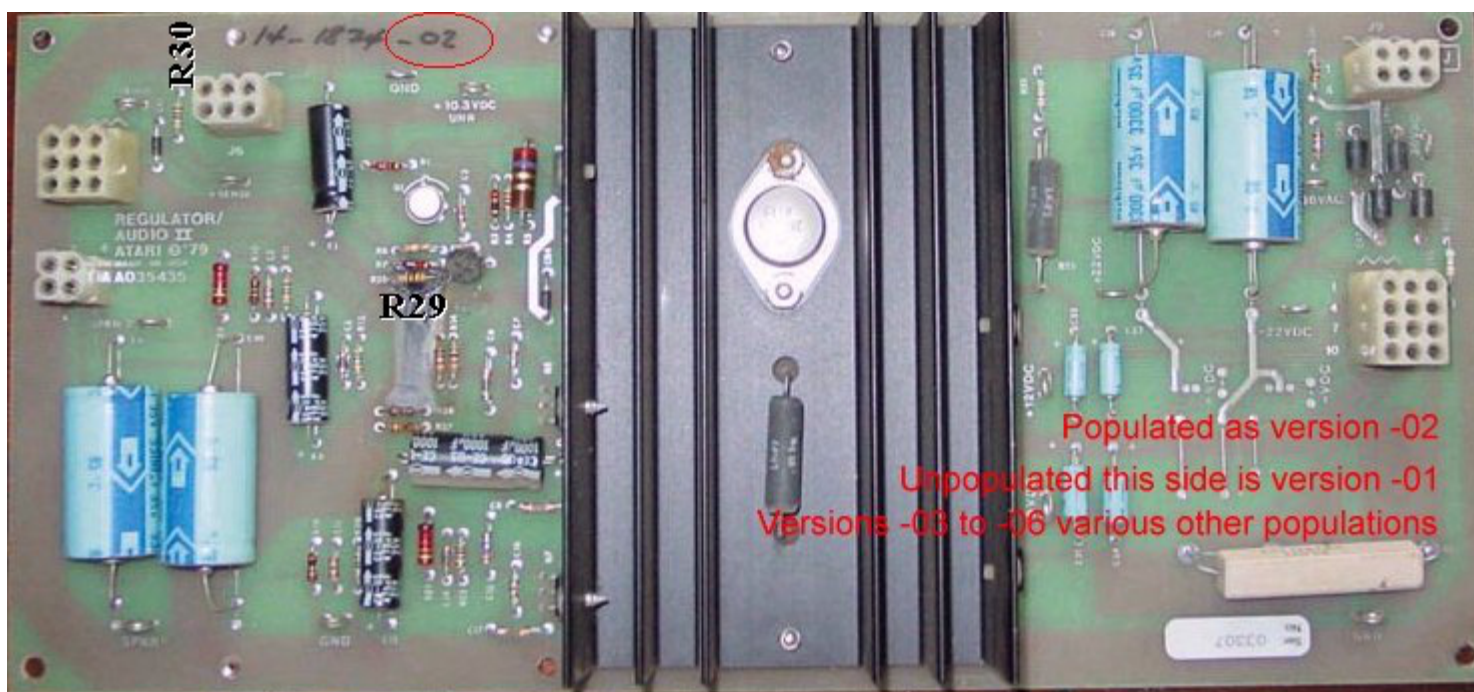












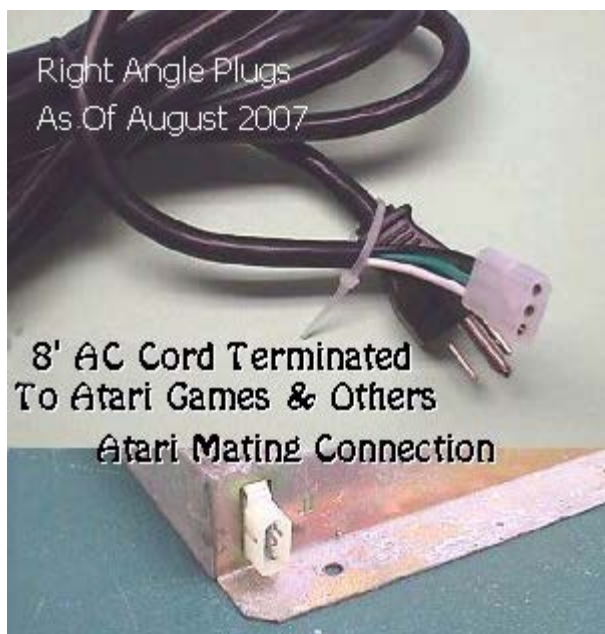
R29 & R30 are 10 ohm differential resistors for the sense lines. Often times the pins in the game edge connector that correspond to these sense lines make poor contact to the PCB causing the added current draw to char one of these. Most times the resistor is still good but, for aesthetic value, a 10 ohm resistor is included in the A/R repair kits. You should clean & tighten, or replace, the offending pin in the edge connector, as well.





The obsolete fuse block pic'd on left ran out 14 years ago & the type on the right has been included in kits since that time. Greg C requested an updated pic so I took time out to add a pic here. Only 14 years late!







Flat 3-Wire Cord Available If Desired At The Same Price

Atari Interconnect Cable

By Bob Roberts



The pic above is of the OEM PCB interconnect cable with the cheap production connectors that made the service industry rich from all the problems they caused.

We make replacements using the "real" Molex connectors. We use the standard .156 crimp pins since I'm in the camp of those who are opposed to using trifurcon pins on I/O, signal connections & on square post headers. We followed the herd back in the early 80's starting with power connections to pins.. especially Bally, Stern & independents using the same plans.. and over the years did not see the promised results. In fact, many times the small, narrow conductors of the tri's would burn or break off causing, more or less, the same problems. Using an ampmeter showed that the tri's actually drew a slightly higher current seemingly no better than the standard ones.

Pic'd below are the 2 versions we make.



These are another item that draw comment from mostly newbies about the cost of them. I won't go into all the comments, suffice it to say that they think they are way overpriced. This one does get under my skin a little bit since the 12" cost us \$28.50 to have made & is priced below that. Another of the wiring loss leaders that we pull to break even through the under a dollar items that have a markup due to being such a pain to deal with.

If you want to cut cost on these then the thing to do is supply your own labor. You can buy the materials for \$14 and strip, pin & assemble yourself. I use to do it for you at no charge, but now there is simply not enough time in a week for me to supply any of the labor, the reason we have a full time harness maker.

Happy Gaming....







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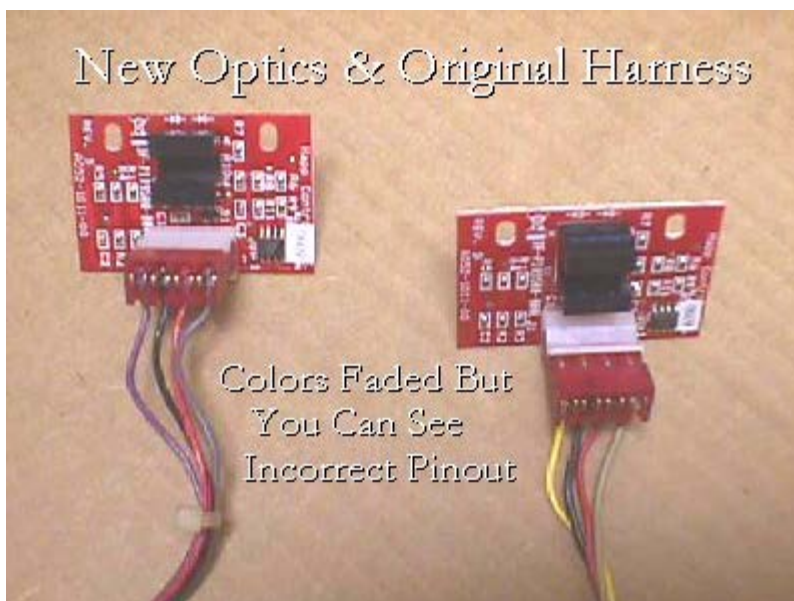
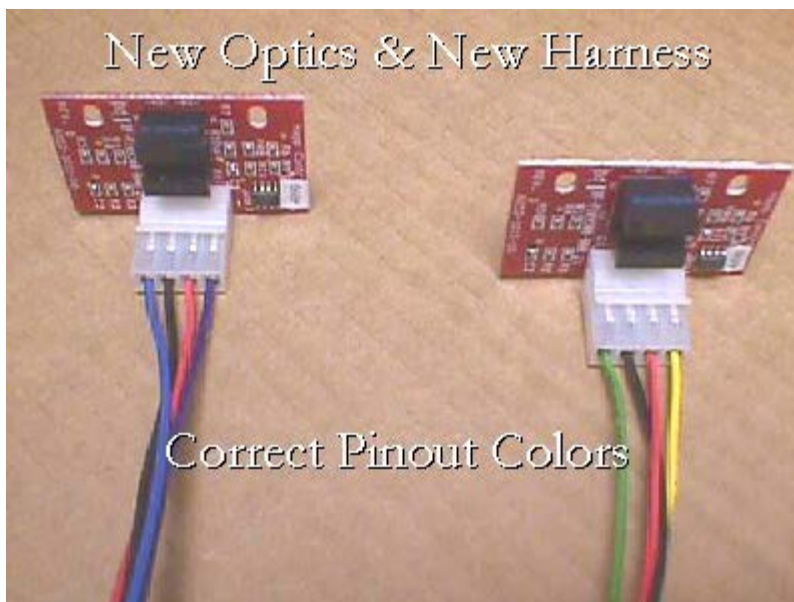
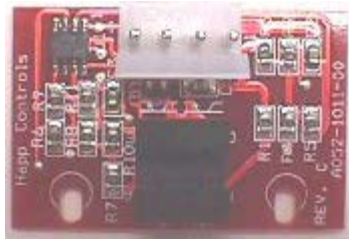


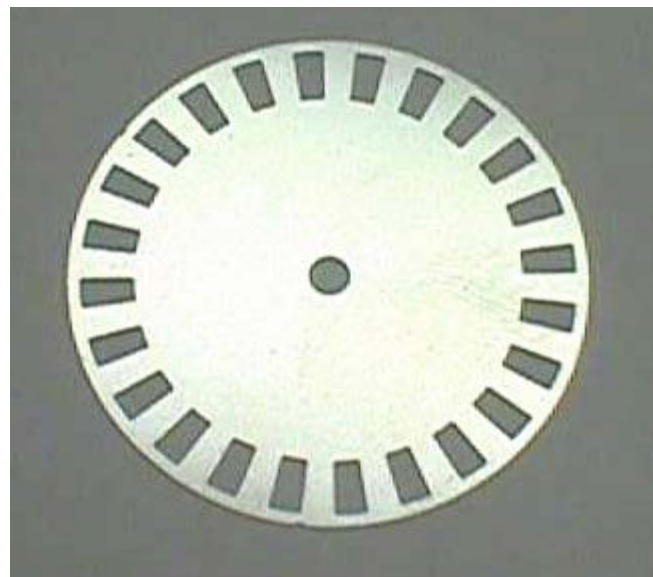


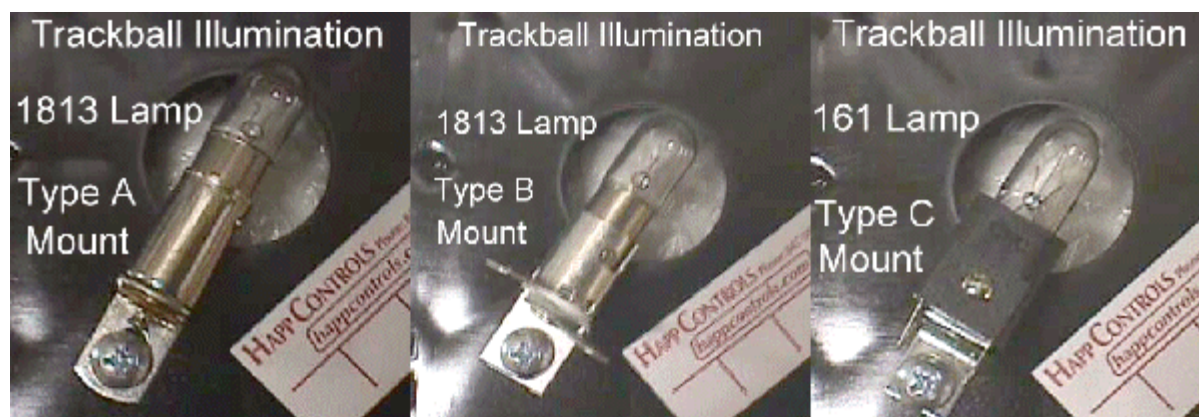




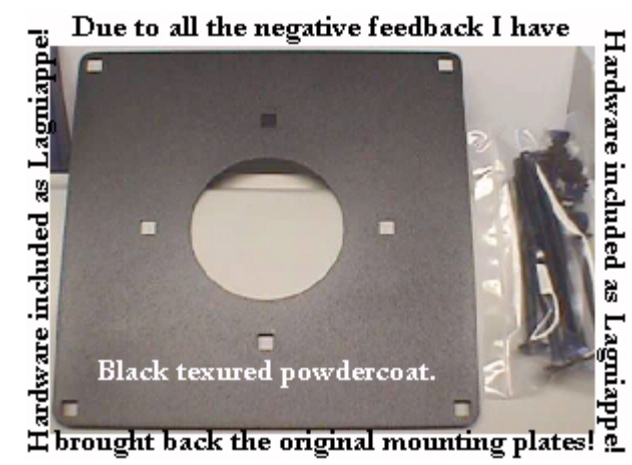
Replacing With Newer Optic Boards



















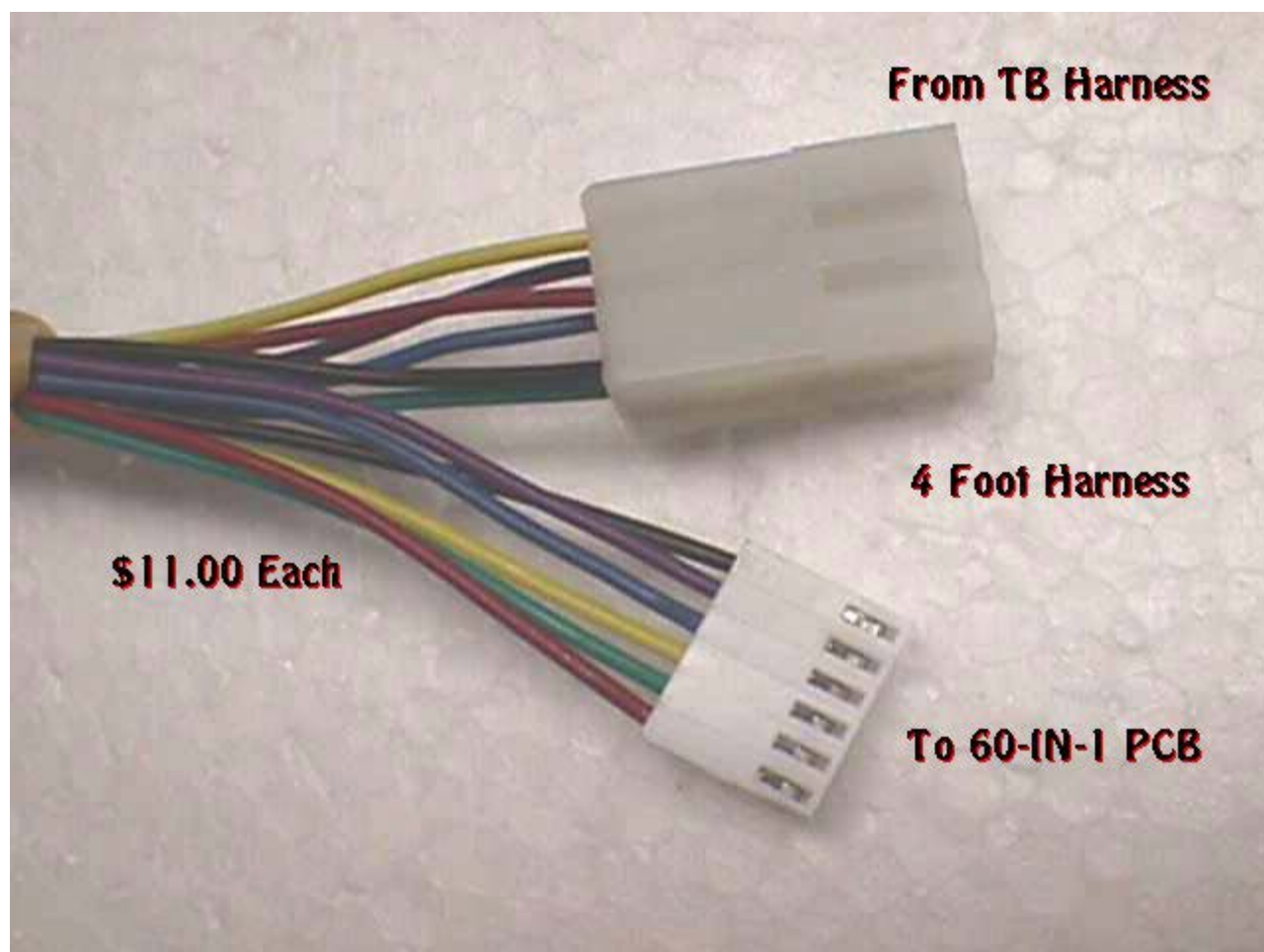


USB-PS/2 Trackball Interface Kit for 2-1/4" or 3" Trackballs

Several of you have requested these Happ interface kits, so we decided to temporarily add them to the Parts Page.



- Kit converts existing 2-1/4" or 3" Suzo-Happ trackballs to work with USB or PS/2
- Simply replace the optic boards on the existing trackball with the included new optic boards and harness
- Connects directly to either a USB or PS/2 port on a PC
- Compatible with Windows 98™, Windows 2000™, Windows ME™, and Apple Macintosh iMac™, Power PC™, with OS 8.5 or higher, Linux™ with USB HID support
- No external power supply needed
- Automatically detects whether it is connected to a USB or PS/2 port and configures itself accordingly
- Supports up to three buttons (sold separately) Includes both .187" and .250" terminal connectors for pushbutton switches







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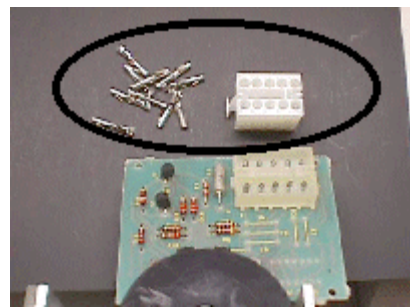








atari-tb.gif %d×%d pixels







Happ No Bolts Showing 3" Trackball Mounting Plate

Back at the turn of the new millennium I jumped on the new 2 1/4" no bolts showing mounting plates & thought it to be a great idea, but as many of you know, there were countless problems with them. After a little goading at first, Happ did start to ship them with the bolt kits, but after hearing things like my bolts stripped... the threads in my post are nonexistent, or stripped ... my post broke off... one of my post is bent... and etc, I have given up on them altogether & quickly dropped them. I had my own plates made up in the old style that have been solid as a rock since their inception & built to last forever. At worst, they might require a new coat of paint & perhaps some new mounting bolts down the road.

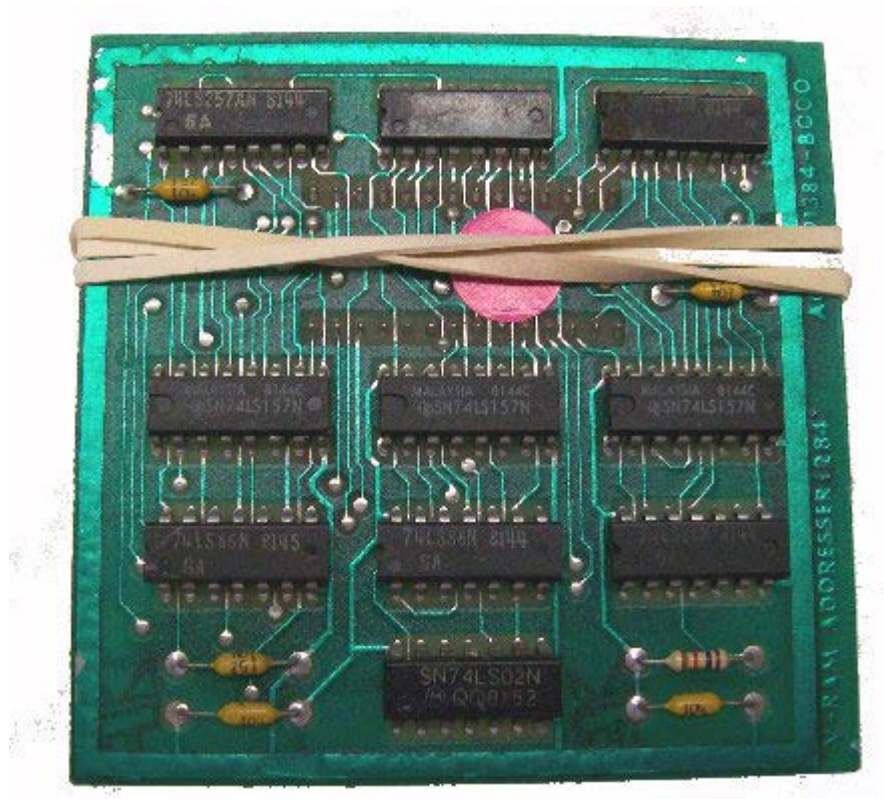
Lately, many of you have been asking me to give them a second chance. I've heard that the 3" is better constructed, that they've ironed out the bugs, that much of the original problems were caused by overtightening & inexperience with a new product & other pro statements. Well... I have no intentions of giving the 2 1/4" another try, but I have kowtowed to the 3" NBS Happ mounting plate... at least temporarily. I have 1 case of them & we'll see how they work out.



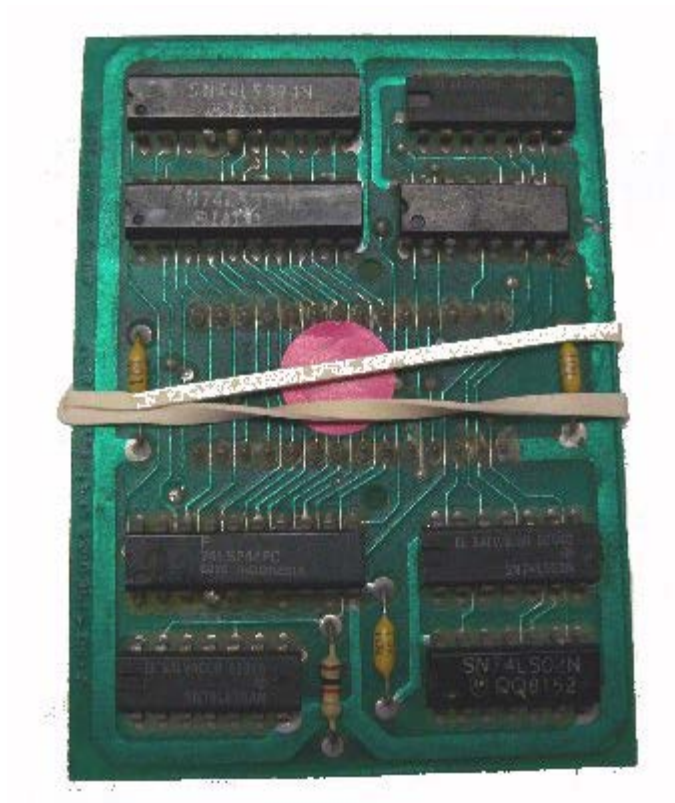
V-Ram Addresser & Z80 Sync Buss Controller

These are the original satellite boards used on Pac, Ms Pac, Pac Plus & Etc. They have all been tested & 100% working. They are sold with the original intermediate sockets that raise the board above lower level components. There is no warranty at all.... you break a pin, mis-pin or install it backwards & you have a wall hanger!

They are priced at \$15 each or one of each type for \$25.00.



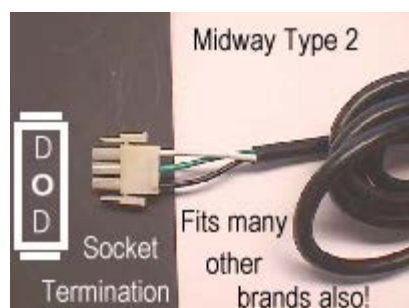
Pac Series V-Ram Addresser (284)



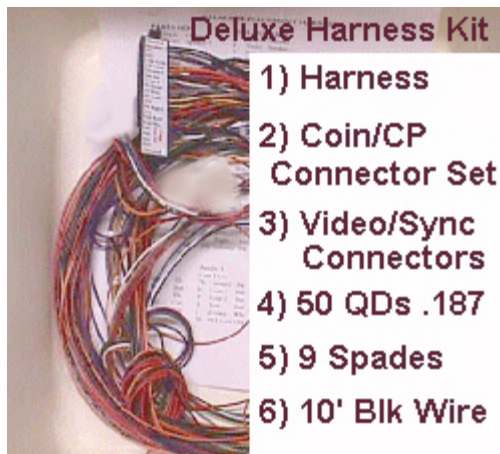
Happy Gaming...

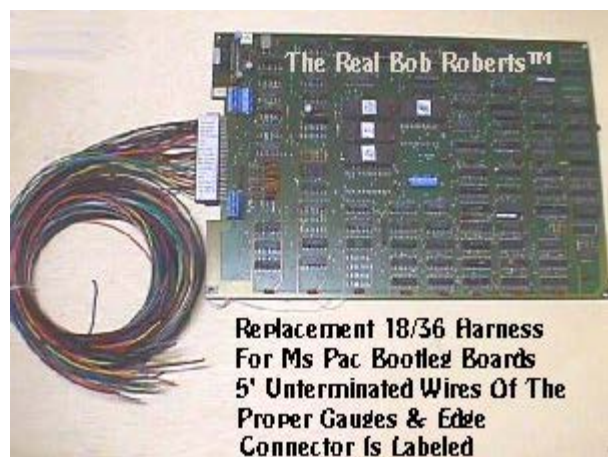


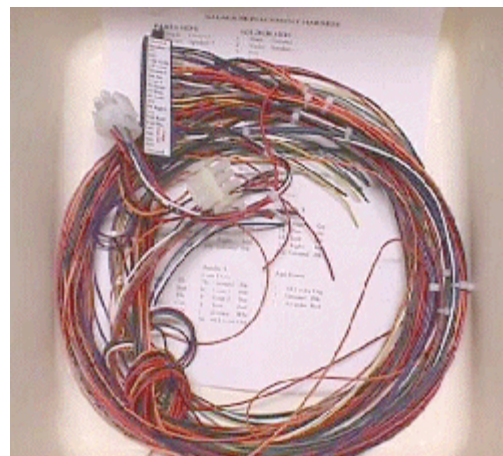
midwayac.jpg %d×%d pixels

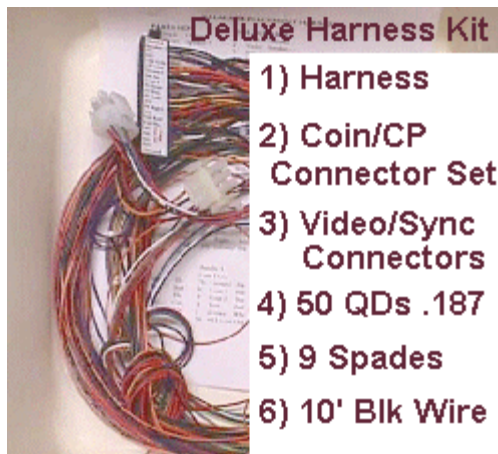












- 1) Harness
- 2) Coin/CP Connector Set
- 3) Video/Sync Connectors
- 4) 50 QDs .187
- 5) 9 Spades
- 6) 10' Blk Wire





This is the accessory pack that goes with the Midway harnesses but it can be used for terminating just about any game harness.

Contains 1 12 position Amp Mnl.
2 9 position Amp Mnl. & 1 2 pos.
1 ea Molex .156 3 pos & 6 pos
9 spade connectors (for PS)
6 QD connectors (for coin)
50 .187 quick disconnects (CP)
10' black wire (CP ground loop)

Pac/Ms Pac Control Panel Harness

Machine Tested
Prior To Shipping

Use With OEM Joy
Or Replacement Joy

The Real Bob Roberts™

Terminated With Quick Disconnects

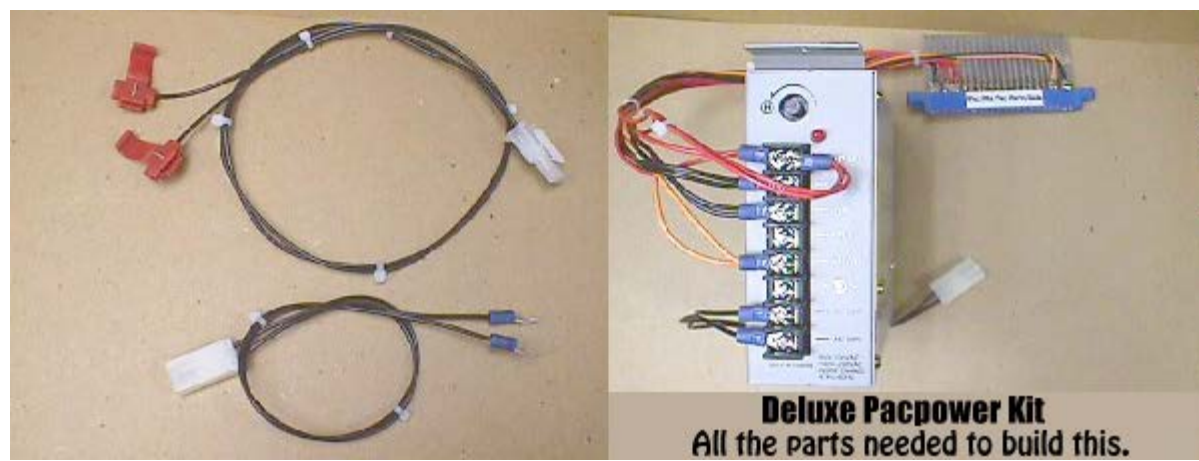
Cable Tied As OEM

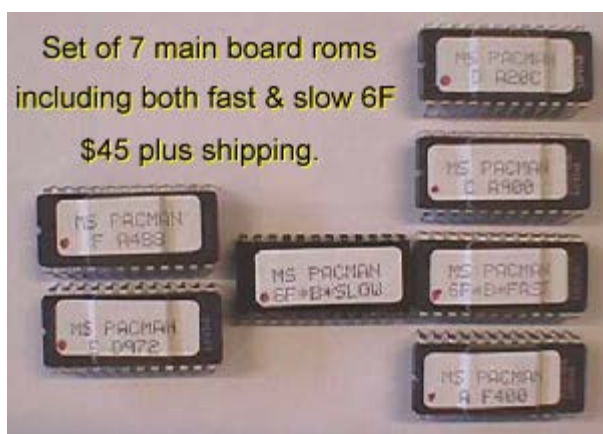
Each Switch Leg Individually Labeled
For Simple Foolproof Installation

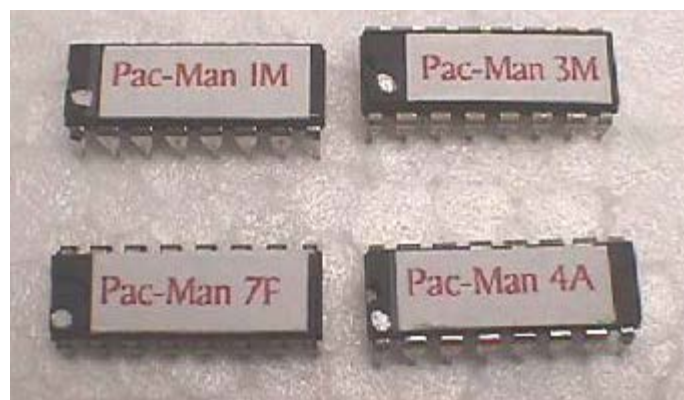
Color Coded To Our Main Harness
Retrofit To OEM Harness

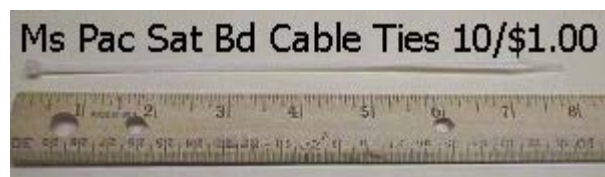
Add New Button Assemblies For \$5 More At Time Of Purchase











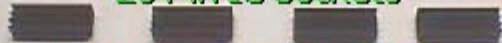
Pac PCB Touch-up Kit

10 Long Cable Ties For V-Ram & Sync Buss Bds

Ms Pac Sat Bd
Cable Ties 10/\$1
The Real Bob Roberts™



28 Pin IC Sockets

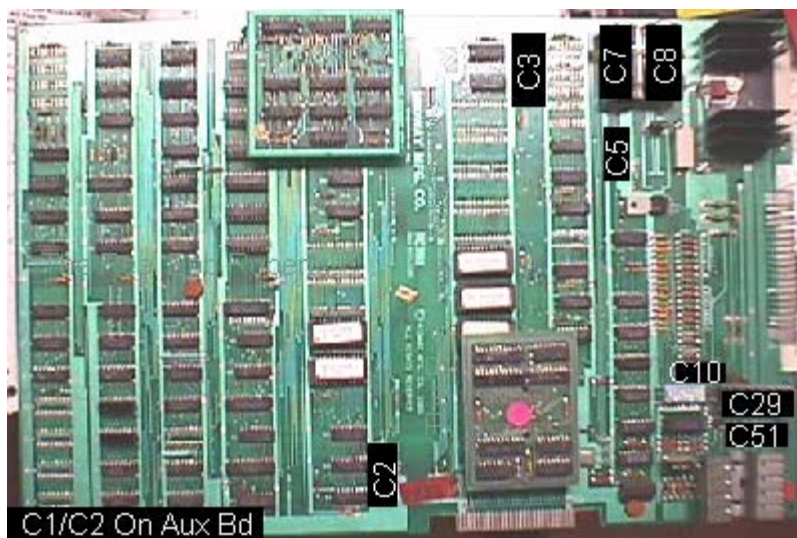


14-16 Pin IC Heatsinks

Super Glue Can Be Used With The Above

Pac/Ms Pac-Man PCB Cap Kit


So many of you have been asking for a kit of all 10 of the axial caps found on the Ms Pac main bd & auxiliary bd that I caved & bought in new axials to make up the kits. I guess that after 20 years of service y'all are looking to refresh them, and without utilizing radials, so now you can. You'll have a couple caps leftover from the auxiliary bd if you're doing a Pac-Man.






Pac series EC & fuse block special.

22/44
Molex
Edge
Conn.
\$15.25

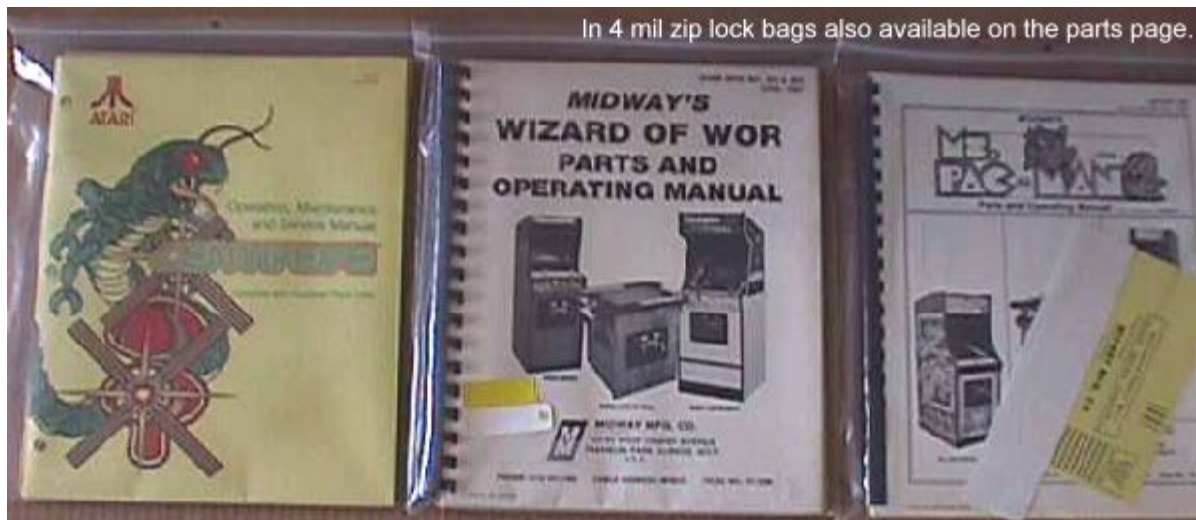


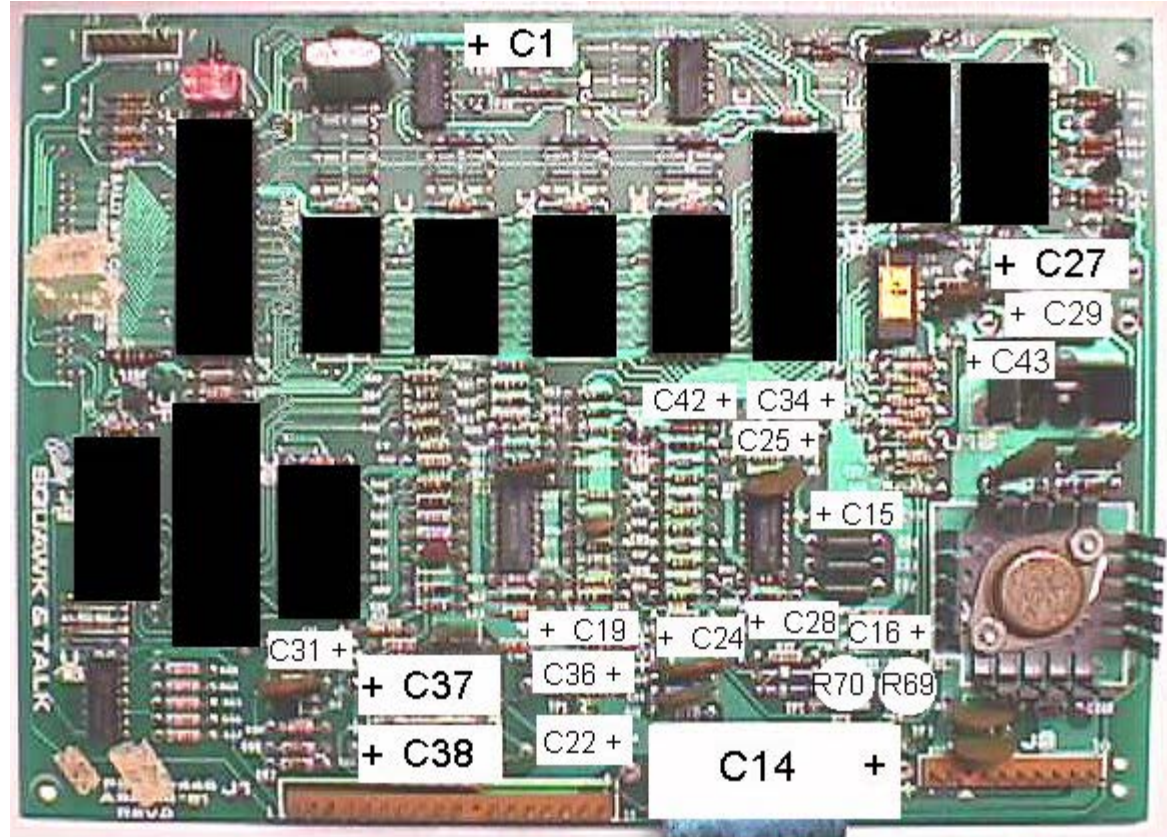
Fuse holder
block. \$4.00



Buy them together for \$19.00

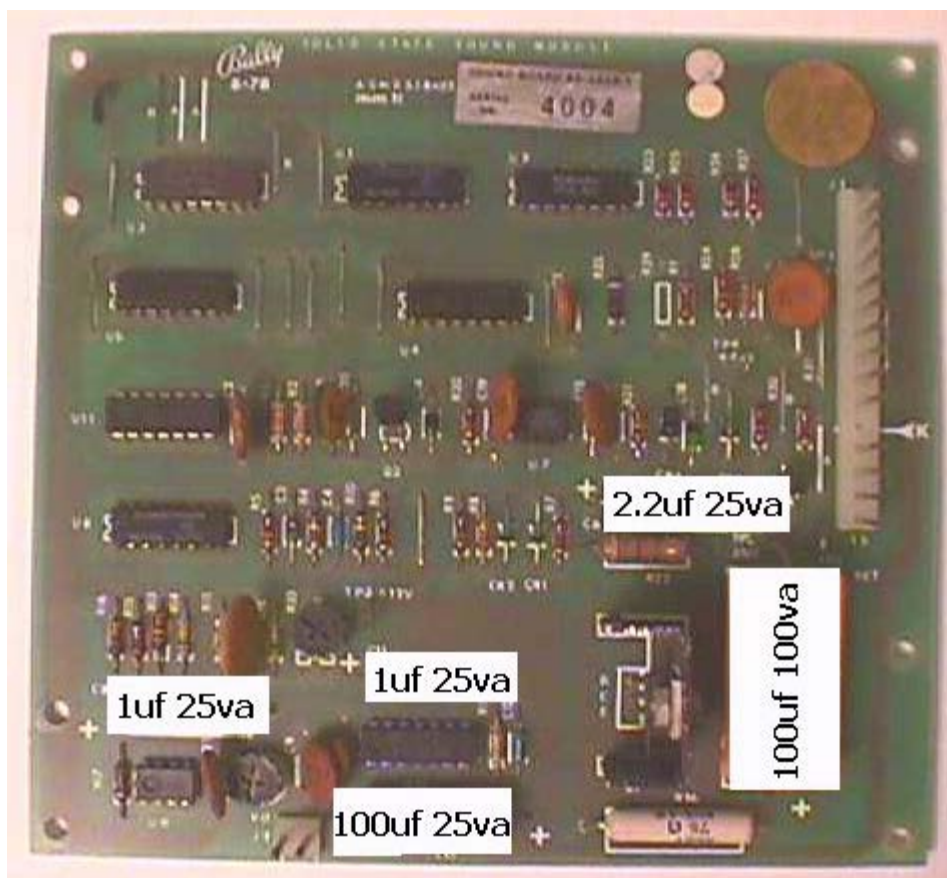
In 4 mil zip lock bags also available on the parts page.



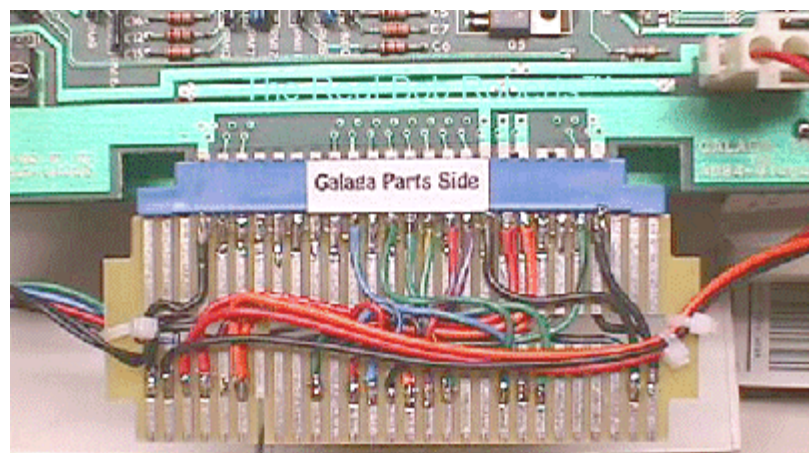


C1	47uf16v	C22	4.7uf25v	C29	470uf10v	C38	330uf50v
C14	4700uf25v	C24	1uf50v	C31	1uf50v	C42	1uf50v
C15	10uf25v	C25	1uf50v	C34	1uf50v	C43	2.2uf25v
C16	4.7uf25v	C27	1000uf16v	C36	2.2uf25v	R69	1K Pot
C19	1uf50v	C28	1uf50v	C37	330uf50v	R70	1K Pot

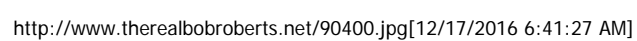
The Real Bob Roberts™







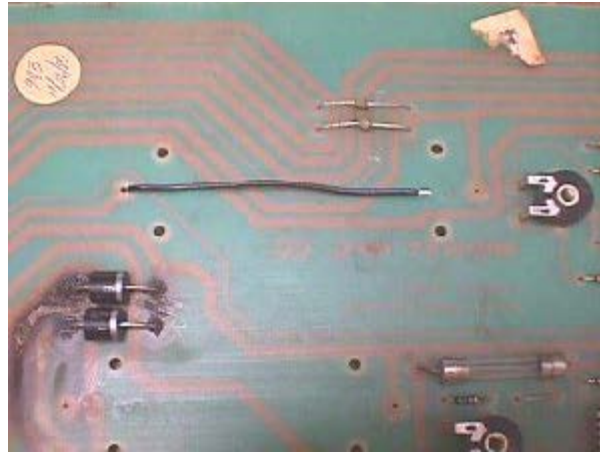




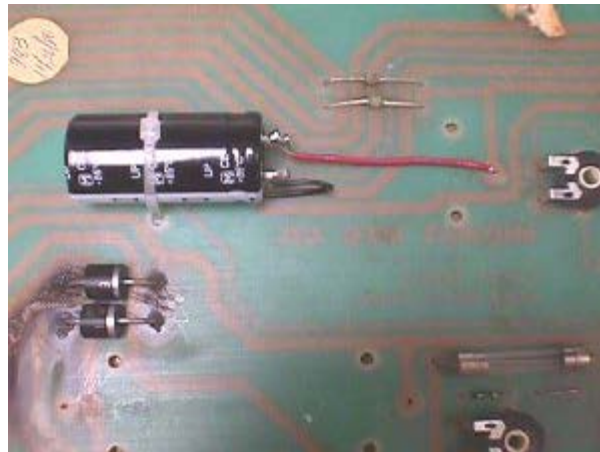
Midway 90411 Power Supply

by Bob Roberts

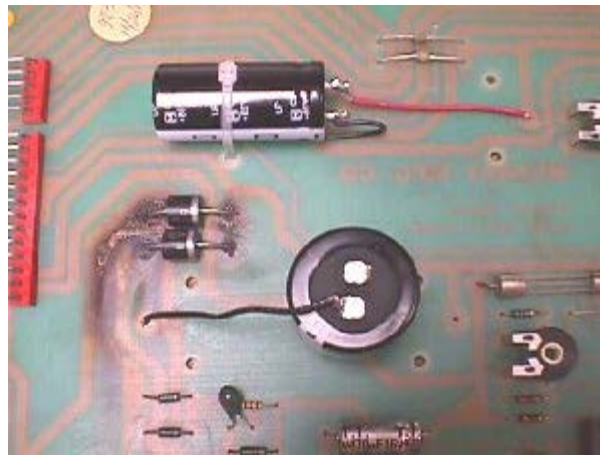
The Midway 90411 linear power supply can be repaired & updated with parts of the current era, as can many of the other linear power supplies. While the huge axial filters of yesteryear are no longer available the newer radials at a quarter of the size can do the same job. All you need to add is wire to extend up from the pcb.



In the pic above you can see the first ground wire that I added in for replacing the 10,000 uf cap & also a typical problem with the diodes D4 & D5 for the +5 volts... an overheated & burnt pcb. I had already replaced the OEM diodes with the 6A1, 6 amp 100 volt heavy duty diodes that will hold up under the load.



After adding the red wire for the positive (+) side of the cap to the + thru hole in the pcb it can be secured in place with 2 4" cable ties through 2 of the existing holes.



Repeat for the 20,000 uf axial cap replacing with a 22,000 uf radial & securing with 2 cable ties.



The other smaller axial capacitors are still available today along with most other common failure parts.... after 20 plus years of service. Below is a layout map of the 90411. You can get individual components from the [Parts Page](#) as needed & I'll make up a parts kit & list it below. The kit should work for many of the common failures on other Midway linear power supplies, as well.

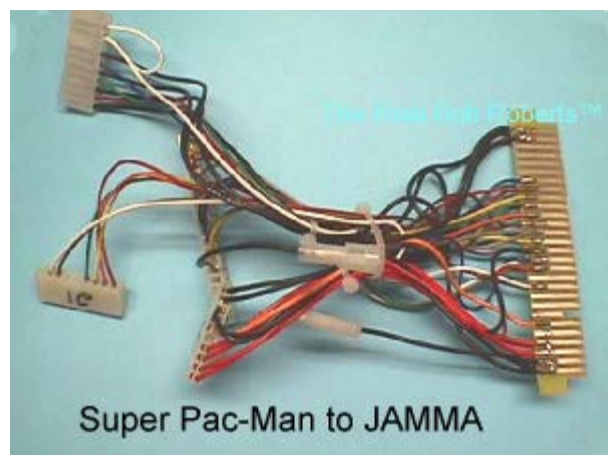
2	18ga Wires 1 red 1 black	12"
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The parts kit can be used with the 90414 as found in Galaga with a few parts left over, but there is no -5 volt regulator, so in that position a TIP31 will be needed.

Midway 90420 Parts Only Repair Kit

5	1N5400	D103-D107
2	6A1	D101/D102
1	100 Ohm Pot	VR101
1	1AFB Fuse	F1
1	2N2905	Q101
1	2N3771/2	HSA1
1	470uf25va	C104
1	4700uf25va	C106
1	22,000uf25vr	C105





MCR 90412 Harness Side Connector Kit

These are the mating harness connector halves to the PCB mount connectors on the 90412 PS. The PCB mount halves are a part of the 90412 repair kit. If you are not using the 90412 repair kit there is a complete connector set available.

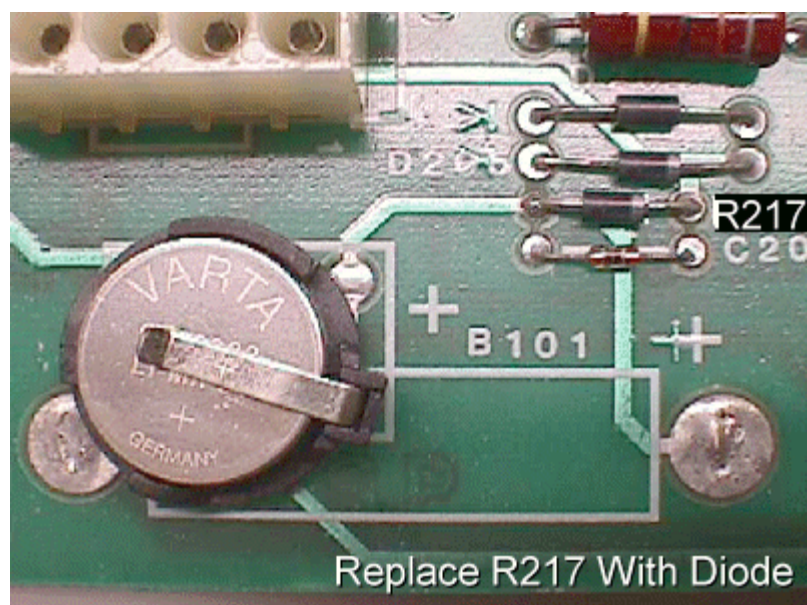


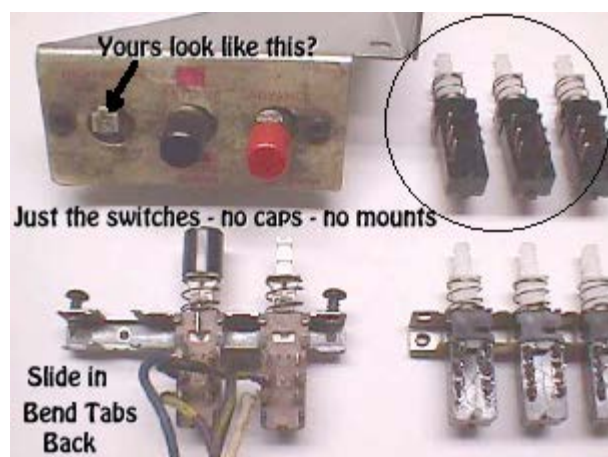




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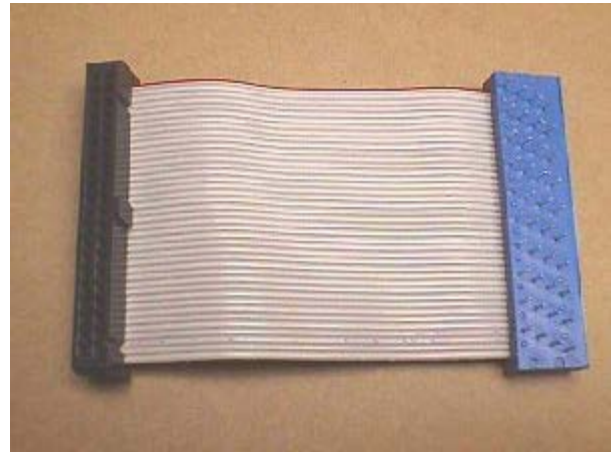


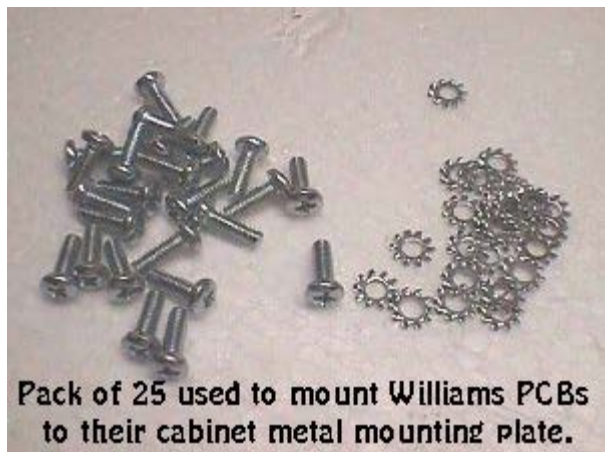


redcaps.jpg %d×%d pixels



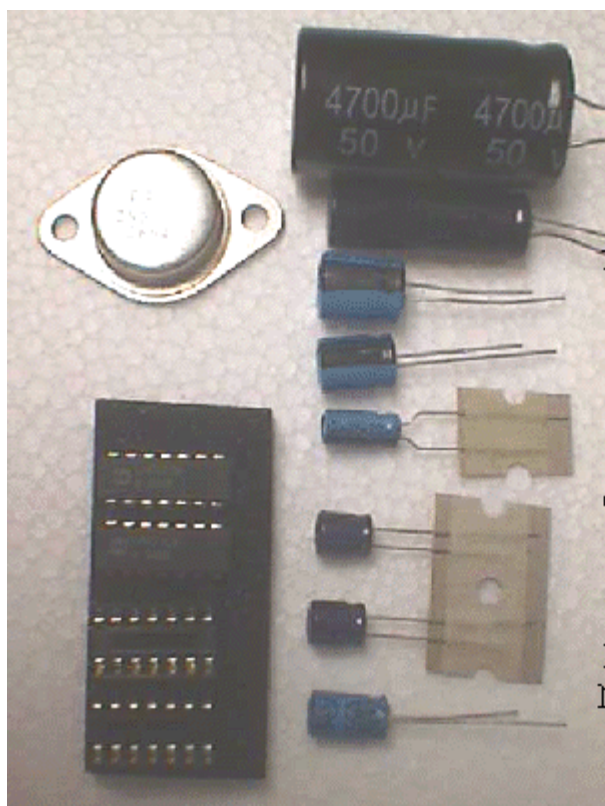












LM723 x 2
+ Sockets
2N3055
22uf10vr
47uf50vr
100uf25vr x 2
220uf16vr
330uf10vr
1000uf25vr
4700uf35vr

Components
Are The
Same For
Both Styles
But Positions
Numbers Are
Different

d-repair.gif %d×%d pixels





Williams Deluxe OEM PS Repair Kit

by Bob Roberts

OK... I've heard it enough times now. Seems many of you like to change all the lighbulbs in the house when one goes out & keep asking me to include other go/no go components in the Williams repair kit. The current kit is of just the common components that fail allowing you to shotgun for them & I've been asked too many times to include all the bridge rectifiers, a number of times to include headers & few less times on the 2N6057/9, so here is a deluxe kit that consists of the current repair & connector kit plus the following items:

- 2N6059
- KBPC-3502W Bridge Rect 35A 200V wire legs BR1*
- KBU401 Bridge Rectifier 4A 100V BR2
- AL156 Bridge Rectifier 1.5A 600V BR3
- 18,000uf35v radial to replace existing axial
- 2x 24 position .156 break-away header
- 2x T0-3 Insulators
- Packet of Heat Sink Compound
- Fuse Kit

* The tab type KBPC-3502 can be subbed if needed.



That is all of the components that have been requested to add to the kit to date. If nothing else, it provides a laundry list of the components used.

Happy Gaming...



Williams Decoder Rom Replacements

by Bob Roberts

Williams used the Harris 7641 proms for decoder chips on the main board for their games such as Defender & many others of that era. Right from the get go the blanks were hard to find & very expensive. I still have a few of the leftover blanks that I bought in at around the \$18 apiece range that were really just too expensive to even program according to ops who wanted to keep all their quarters. In looking for a way around these proms, I believe it was Joe Guidry, a great local tech, who suggested dumping the files into 2716 eproms. After a few play sessions this was accomplished & used routinely on route machines... a much cheaper method with readily available eproms.



Skipping ahead to around 9 years ago... long after these games were on the street... hobbyists were asking for WMs decoders & since I had blank 7641s to get rid of before my retirement in 2000 I began programming them once again. They went so quickly that I held out a few in case an occasion arose where I might need them. Once I stopped selling them many of the guys were asking about alternate chips for the decoders, so I went back & found my files on an old 5.25" floppy disk... which I can now say is not a very good way to store them, but it was all we had available at the time, without killing a hard drive... and I tried programming them as I had many years before, but I gave up after several attempts without getting them to work. Old age is a terrible thing.... I had forgotten how to make them work, right along with thousands of other things that I like to think I had to forget in order to make room for all the fast paced new technology in games, monitors, power supplies, gaming machines & even vending machines. Just when you learn enough to get repairs done in a profitable amount of time & think you know everything there is to know about a game, something new & very different has come along to take it's place & you have to clear your mind & start all over again :- (What! It's not hard wired! It has solid state devices... huh... what's that?

Well... a few of y'all kept after me to get the eproms working & most persistent was Mike Ranger & a friend of his. Finally, he said... Bob, just tell me that it can be done for sure & we'll figure out how to do it! I believe they did just that, too, although I

don't know for sure. In any event, sometime in 2000 I had a few minutes to call my own & I was looking for some things for another Help Page project when I stumbled onto a box of zero ohm resistors & before I could even wonder about them, it just popped into my mind where I had used them & what for. Yes... with the decoders & later on pinball machines & poker machines. Since I hate hacked bds I always did my best to use wire wizardry for rerouting & the zero ohm resistors helped to do that with eproms. In the case of the decoders it was just a matter of grounding the chip select line which was held high on the WMs bd, so lifting pin 18 from the socket, & running a zero ohm resistor to pin 12 grounded the select line without any bd hack. This is how we had done it on the streets. F1 or faster eproms work best, but eproms are less forgiving, so everything else on the bd must be up to par including the supply voltage or they may not work where a 7641 would.

Later on I found that since pin 19 of the eprom is a "don't care" pin it can be lifted as well & provides a closer ground via pin 20 eliminating the need for the zero ohm resistor. The chips can be verified by a programmer in their Frankenstein state, as well, making it easier to t-shoot down the road.

I removed the decoder sets from the Parts Page last August. I had one complaint of the sets not working in 2001 & 2 complaints in 2003... I now know one of these to be an installation error (4 & 6 swapped as erroneously pic'd in the Joust manual) & one with a bad 74xx... and in 2004 I got a complaint from a tech experienced with WMs bds saying that they did not work in all bds as they should, so I pulled them until I could look into it further. The complaintant added... "I had a problem with another pair in that the pair worked on a Joust CPU board but would not work 100% on a Robotron CPU board."

In the interim I have been selling sets to regulars with the understanding that they may not work in all cases & I have been pulling old bd sets & jiggling them up with chip sets burned into various eprom brands for trials. I've not had anyone say that their set did not function for them & I have tried the chips in Stargates, Sinistars, Robotrons, Jousts and a half dozen Defender bds without incident, so I will be adding them back to the Parts Page, but with this disclaimer that they may not work for you. I've got so many already made up from the experimenting that I'll lower the price on them, as well.

I feel that these are necessary to keep around for a couple reasons. The proms are sometimes pretty cooked & even though they may be working in general, there are 2 problems that they can be the source of. The first is erroneous ram error reports... I hear this many times... I've changed over to a switcher & replaced all the rams & still get a ram error (131 most common one) and it almost always is a decoder fault at this stage. The second one is HS save failing intermittently even after changing over to a lithium battery & changing the CMOS ram & at this point it is often a decoder fault. Lastly, it's the least expensive way to keep the CPUs running.

Update 2007

The 100ns & 150ns eproms are getting nearly as expensive as the proms and in my searching for the eproms I came across a cache of the proms at a reasonable price, so I am going to go back to using them for as long as the supply last.



WMs Decoder Prom Set 1 & 3 - \$20.00



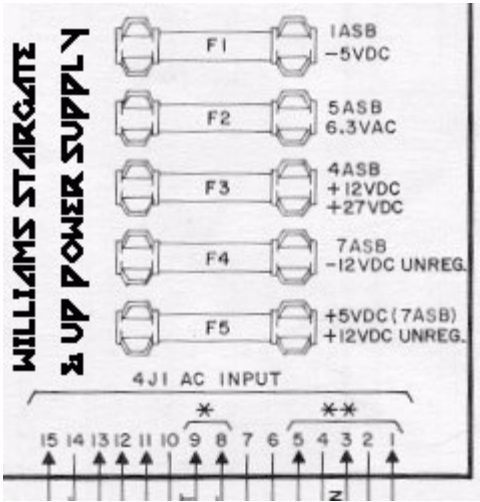
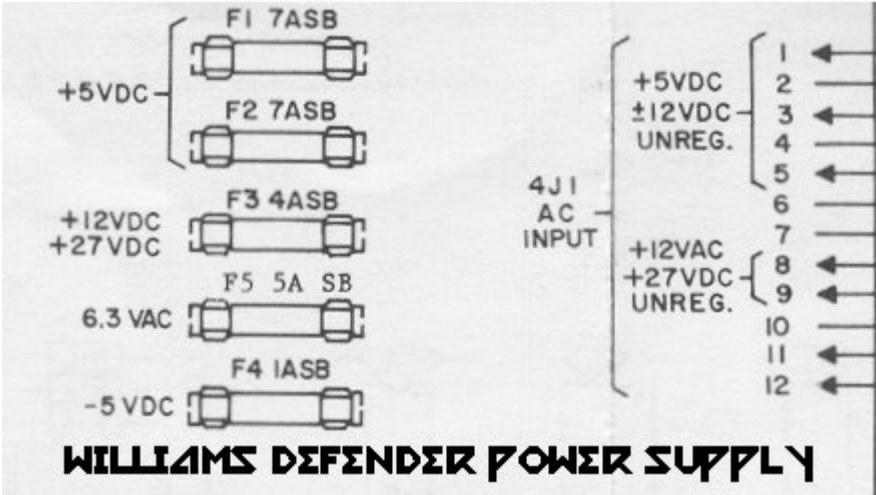
WMs Decoder Prom Set 2 & 3 - \$20.00

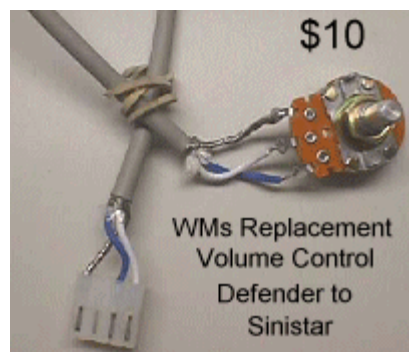


WMs Decoder Prom Set 4 & 6 - \$20.00

Happy Gaming...

WILLIAMS LINEAR POWER SUPPLY FUSE LAYOUTS
Fuse Kit Available Covers Both Types
Contains 1ea 1ASB/4ASB/5ASB 2ea 7ASB







Williams To JAMMA Connector Kit

Main Board

- 1J1 - 9 pos key at 4
- 1J2 - 4 pos key at 2
- 1J3 - 7 pos no key

Rom Board

- 2J2 - 6 pos key at 3
- 2J3 - 10 pos key at 9
- 2J4 - 9 pos key at 1

Interface Board

- 3J2 - 10 pos no key
- 3J3 - 10 pos no key

Sound Board

- 10J1 - 9 pos key at 9
- 10J2 - 4 pos no key
- 10J3 - 9 pos key at 1
- 10J4 - 4 pos key at 3

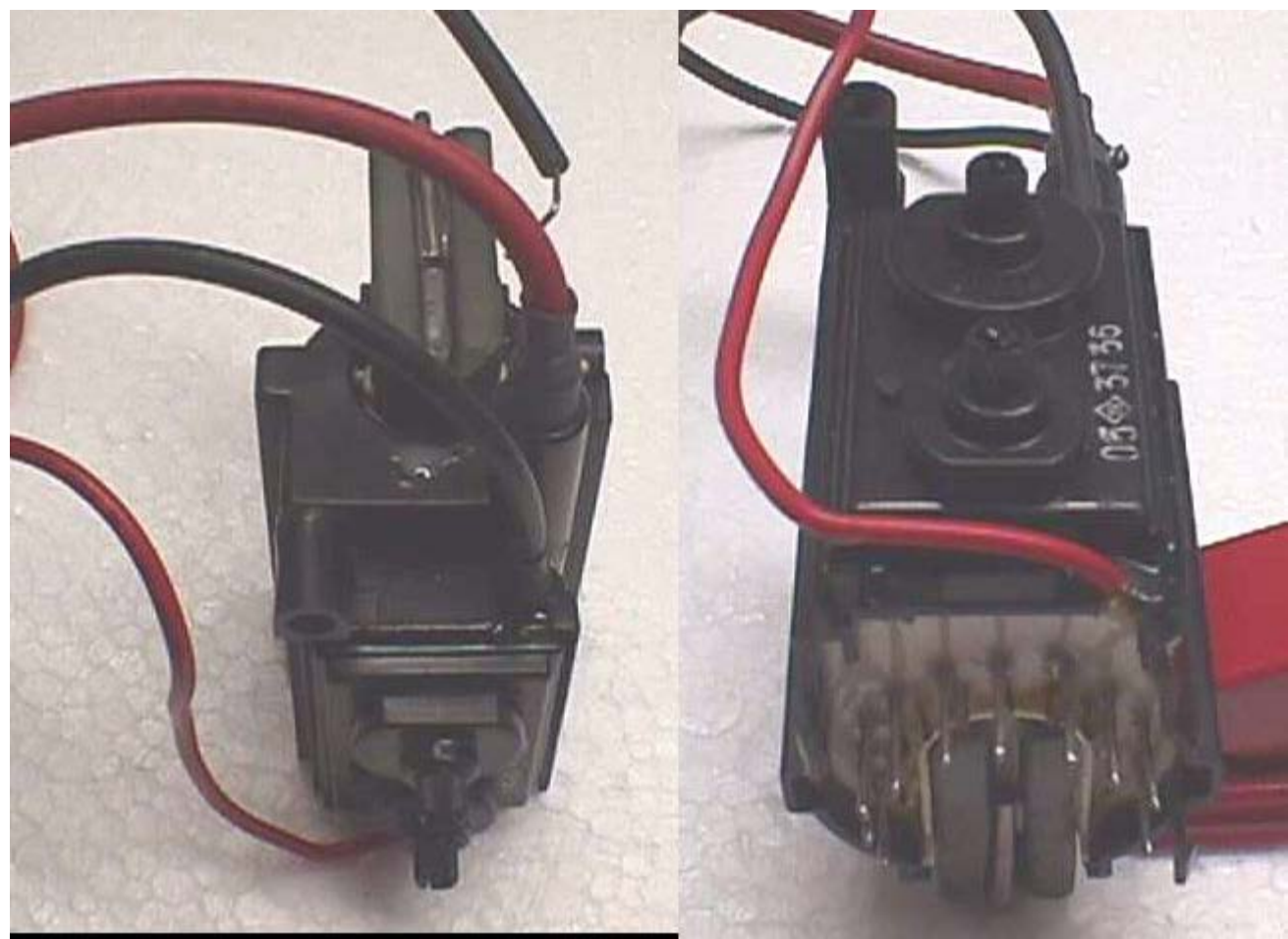
Contains the following:

- 12 Housings 3-4 pos/1-6 pos/1-7 pos/4-9 pos/3-10 pos
- 100 .156 pins
- 8 Key plugs
- 1 Type 1 Fingerboard
- 1 Volume pot
- 20' Red 18ga wire
- 15' Orn 18ga wire
- 10' Blu 18ga wire
- 20' Blk 18ga wire
- 1 10x10' 20ga wire pack

Flyback & Caps Kit

**Get your cap kit along
with your flyback for your
monitor & save a dollar
or two.**



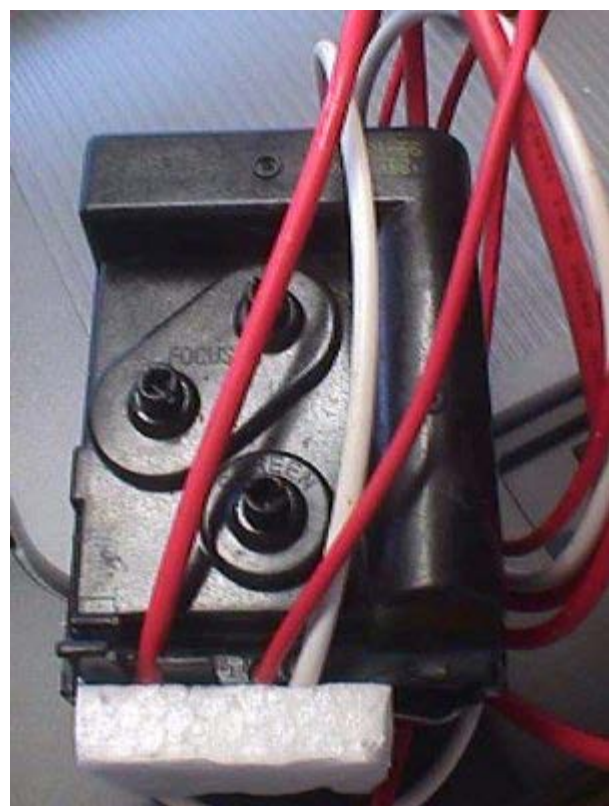


Located a case of these Kortek flybacks.

Imperial #44-4025-1
13" & 19" With Samsung CRT
FN-1441BA
MCG-20A34
HR 46253

Net Info Models
KT-1401 & KT-1901
Perhaps Others??
\$35.00 Each

The Real Bob Roberts™









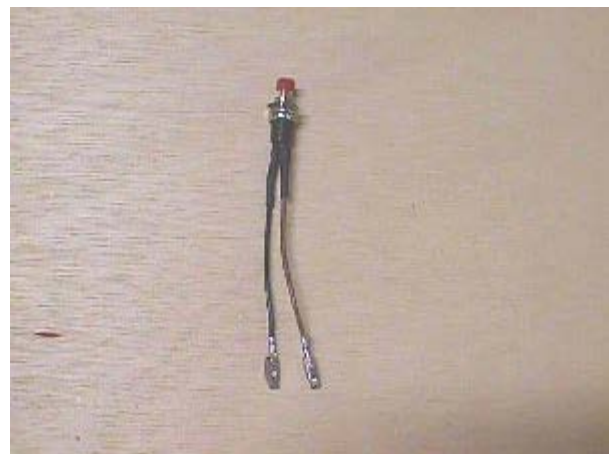
10' Isolation Xformer To Monitor Extension



This extension will aid in supplying isolated AC to the monitor in conjunction with the RGB extension cable for troubleshooting purposes. One end is terminated with a .093 2 pos Molex plug and the other with .25 QDs. There is a Molex .093 2 pos connector inserted at the 9' mark for iso's that use them.

<p>CHEAP INTERMITTENT MTA CONNECTORS & RUSTY SOCKETS BUGGING YOU ?</p>  <p>NEED TO RESOLDER YOUR HEADERS CAUSED BY THE CONNECTOR RAMP OVER TIME ?</p>	<p>XY OUTPUT HARNESS \$12.50 SHORT SET 6" & 8.75" LONG SET 7.5" & 12.75" CUSTOM SIZE AVAILABLE</p>  <p>RAMPLESS TO SAVE YOUR HEADER JOINTS</p>
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pstestb.jpg %d×%d pixels





Cab AC Wiring Starter Kit

- 1 AC Line Cord
- 1 AC Fuse & Holder
- 1 AC On/Off Switch
- 1 AC Distribution Block
- 1 AC Line Filter
- 1 Bag 4" Cable Ties
- 1 Cable Clamp Assortment
- 1 18ga Wire Pack
- 1 Misc Connectors
- No Isolation Transformer

Price: \$50.00

Cab DC Wiring Starter Kit

- 1 Super-Super Economy Jamma Harness Kit*
- 1 15 Amp Switching Power Supply
- 1 Bag 4" Cable Ties
- 1 Cable Clamp Assortment
- 1 20ga Wire Pack
- 1 8 Ohm 5 Watt 4x4 Speaker

Price: \$95.00

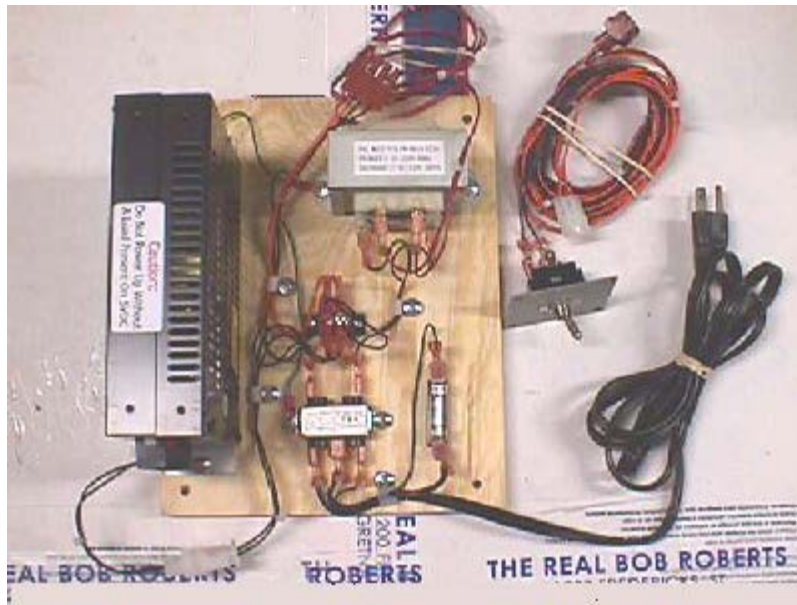
* Add \$5 to sub a Neo or fully loaded harness.

Buy both AC & DC Wiring Kits for \$140.00

Sub with Deluxe Pac Harness Kit \$155.00

Special Purchase * HT-1921 Crimpers when you buy either kit * \$15.00

Drop-in AC Power Center



Update 2014: We still make this drop-in center, however, they do not come with isolation transformers since they have been discontinued, so if you're using a monitor that requires isolation you'll need to add one. The price is the same since the grandson that was doing them for fun is now in his 4th year of college up in Baton Rouge & we only see him on holidays:-) It cost us \$50 to have our harness maker assemble them to almost drop-in... you'd have to use a good used iso or get one from Happ Controls while their hoard of new ones lasts.

Here's something that many of you have requested over the years. I don't have the time to do them... it's taken me a month of stolen minutes to just layout all the plans for it, but now it's setup to be made on demand. One of our grandsons wanted something to do for a little spending money & is at that age where he has his eye on a new automobile, so he's been in training, learning all aspects of producing these drop-in AC power centers.

The center consists of all the AC wiring & components for your cab including an isolation transformer, so that any monitor can be used without any big surprises that a few of you have had when trying to put an older monitor into a newer cab that never had an isolation transformer. It comes complete with the on/off switch & mounting plate, line cord, filter, fuse, distribution block & switching power supply. I designed it with two things in mind... making it so that you can easily remove the unit without having to remove your entire wiring harness, and maintaining a size that would fit into a USPS flat rate box for shipping, affording a practical way to get the weighty center shipped.

It also comes with an accessory pack that contains the mounting screws, cable clamps & screws to neaten up your wire runs, a few cable ties & mating connectors to the monitor plug & the marquee fluorescent in case yours are different.

The cost of the materials on this unit come to \$80 & my grandson says he'll cut them out & assemble them for \$10... this may change in a hurry as I wasn't able to convince him that it wasn't enough for the amount of time it'll take him... bringing the total cost to \$90 & with flat rate shipping of \$10 it'll top out at a \$100 investment for a complete AC power center.

March 2013

Well... it held for a little over 6 years, but with everything up to & including postage going north we are forced to raise this closer to a break-even price. The AC center is now priced at \$120 & with \$12 flat rate shipping it is pushed to a total of \$132 to your door in the USA.



July 2009:

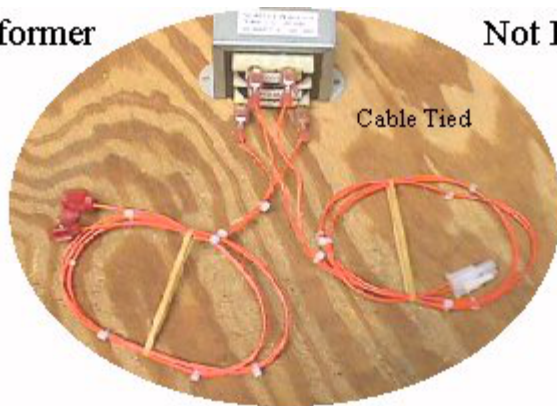
This hot & wild summer with days all in a row over 100 degrees had my grandson begging for air conditioning in the carpentry shop, but he agreed to several more new fans to keep prices on his projects at the current level.

Happy Gaming.....



Transformer

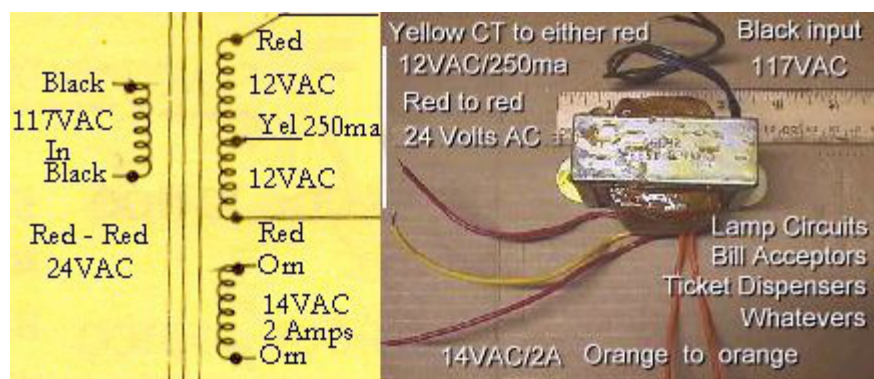
Not Included



Isolation Ready Made Harness

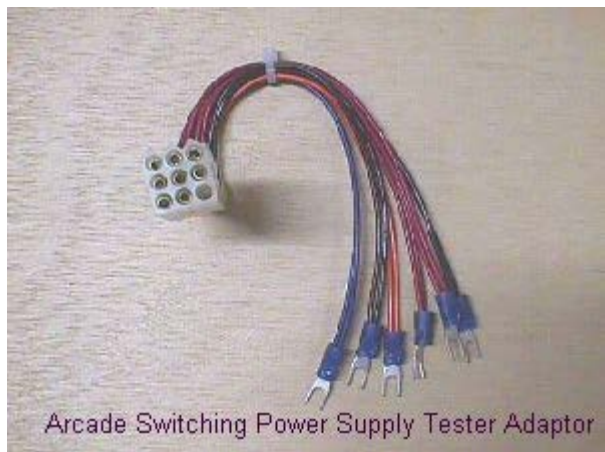
3 Feet Wire In W .25 QD To Accommodate Any Iso Input Tabs
On One End & Quick Splicers Terminated On The Opposite End

3 Feet Wire Output W .25 QD To Accommodate Any Iso Output Tabs
On One End & Molex 2 Pos Monitor Plug On The Opposite End



Hook the two black wires up to your switched AC line and you'll have several selections for output voltages. Use either red wire and the yellow wire for 12 volts out. Use both red wires and you'll have a 24 volt output. Use both orange wires and you'll have a 14 volt output. Unused wires can be capped off or put into a connector. The 12v output was not heavy enough to power our 12v jukebox libraries, so we used the 14v output on all of those large motors with no problems.

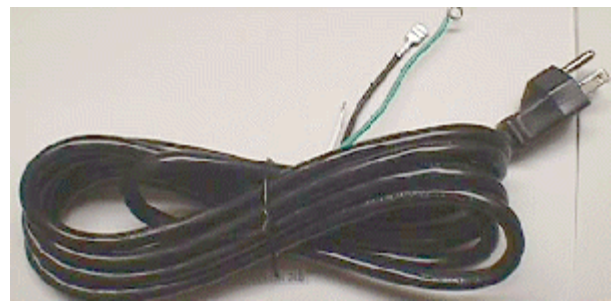














We Can Add A Mfr Connector For \$1 More

10 Foot 18 Gauge Line Cord

Y/G Earth Ground Brown Hot Blue Neutral

12 Foot 16 Gauge Heavy Duty 3 Wire Replacement Line Cord With Right Angle Wall Plug



The Real Bob Roberts™

Makes up for length lost inside the cabinet.



11 1/2' Long Giving You A Couple Feet Inside The Cab
18-3 Flat Flexible Cord With Line Filter Already Attached

18-3 x 6 Foot PC Type Power Supply Cord - \$2.50







One Foot Extension Cord



These are one foot 16ga heavy duty extensions that will allow you to plug in those AC/DC bulky power adaptors away from the outlet, so that other receptacles can be used. They'll safely handle up to 13 amps, so theoretically you could even add a multi-outlet to the extension.

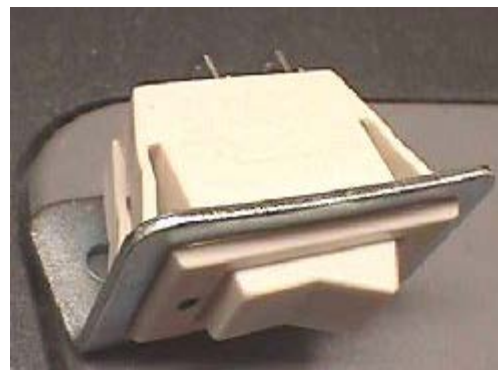
[Site Index](#) - [Big Bear's Bulletin Board](#) - [Parts Page](#)







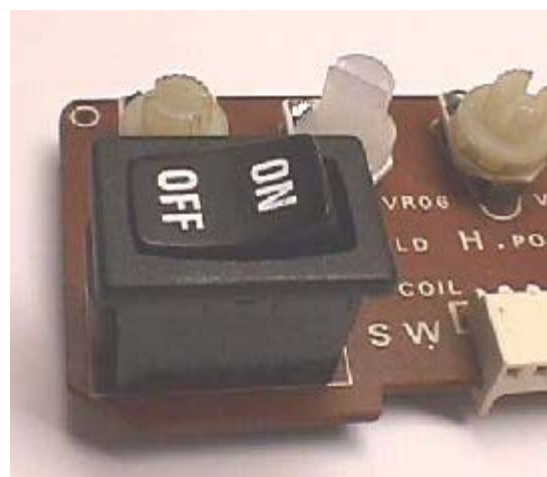
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acswitch.jpg %d×%d pixels







fh1.jpg %d×%d pixels



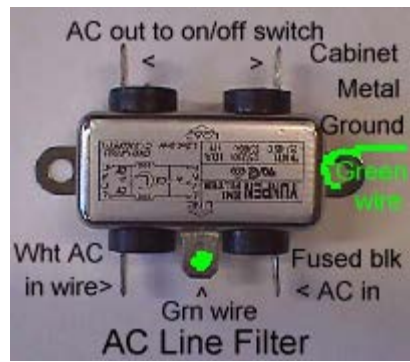
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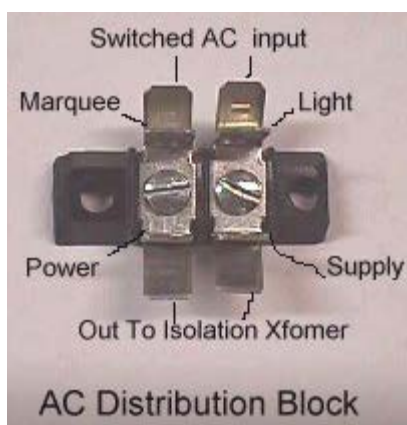




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8/10 Position Distribution Block

An Octet Of Quad .187 Tabs

.187 or .25 Tabs Can Be Used On this One



1 180 .187 QD or Solder Terminal

2 90x2 .187 QD Terminal

3 45x2 .187 QD Terminal

4 180 .25 QD Terminal

5 45 .25 QD Terminal

6 180 .187 QD Or Solder Terminal

7 45x2 .25 QD Terminal

8 90x2 .25 QD Terminal

9 90x2 .187 QD Terminal (Tiny)

10 90x2 .25 QD Terminal

11 Jumper Terminal

12 Jumper Terminal

4 Thru 10 Fit 8/10 Pos Block Only - 15¢ (Not 9)

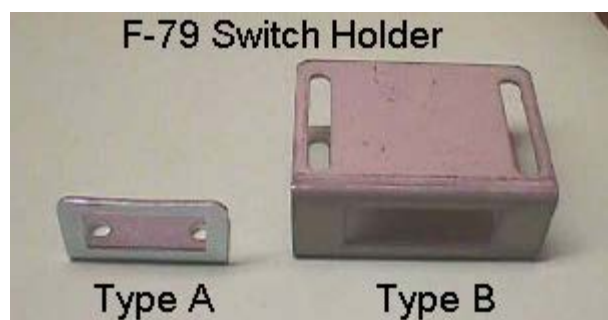
9 Bag Of 100 - \$4.00

1 Thru 3 Fit All Blocks - 30¢ Each

11 & 12 - 25¢ Limited Supplies Available Of All



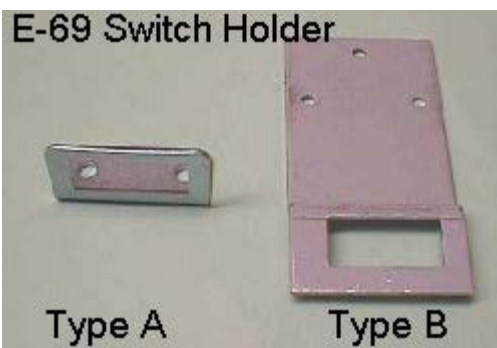


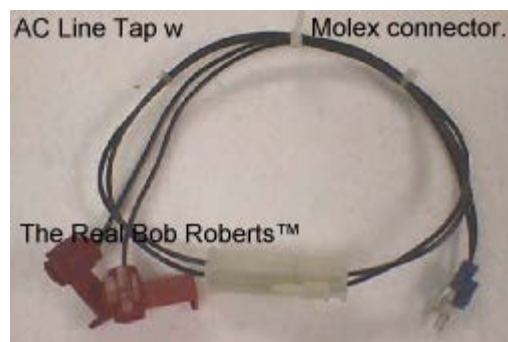


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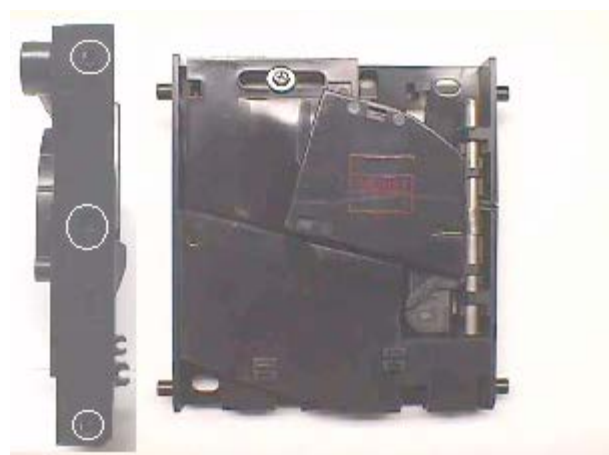














5 VDC Counter w Diode





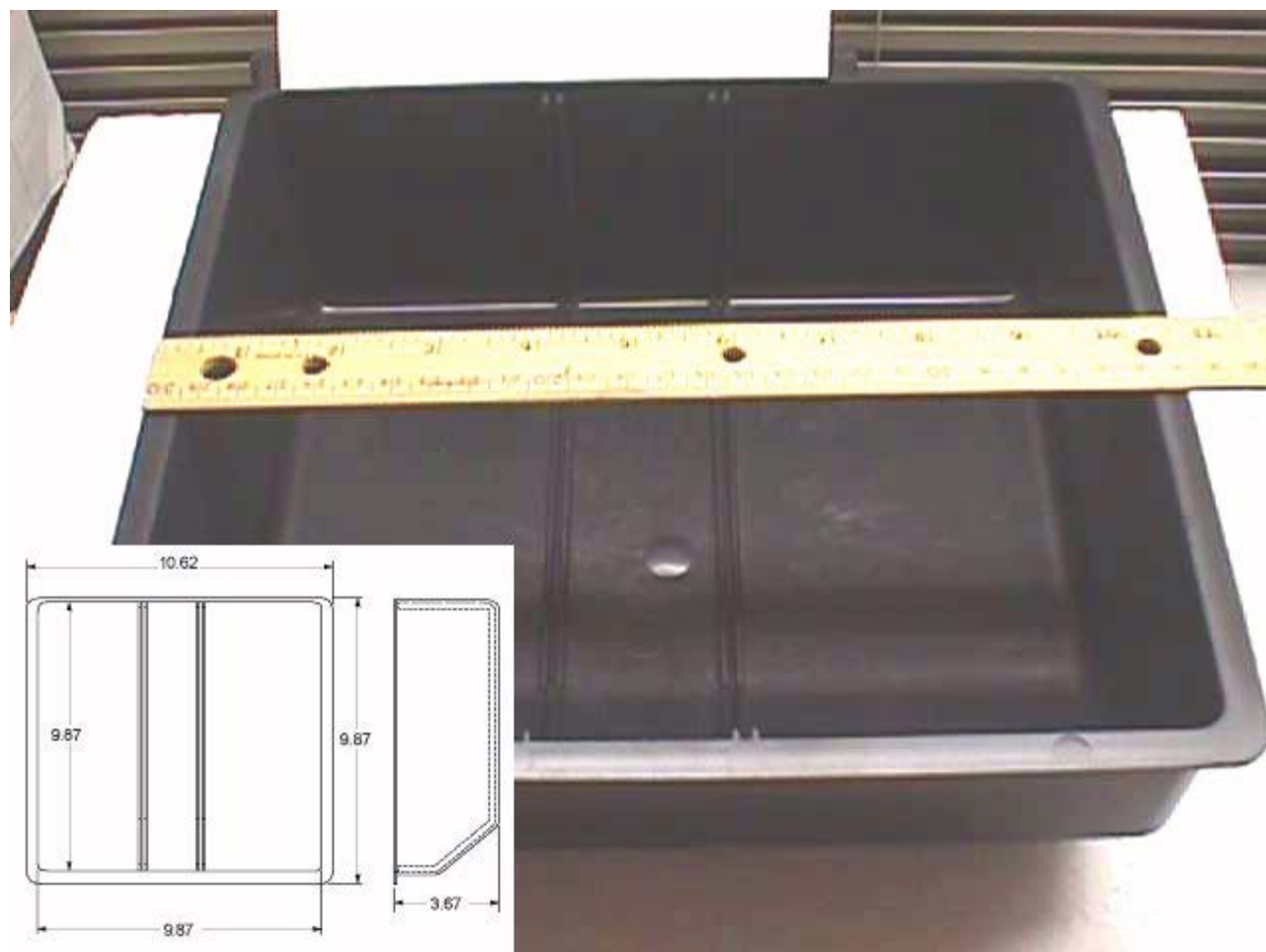


Coin Controls Coin Rejector Insert
Mylar 1.13" x .625" x .01"









coinbox2.jpg %d×%d pixels





dip8.jpg %d×%d pixels













**Dual Mounted Test Switches To 1/16" Aluminum
Bracket With Mounting Screws**





I've had quite a few requests for a heavy duty test switch set up with an on/off switch & a momentary switch for use with some of the newer game bds on the market today, so I came up with one that'll help keep my grandson working while providing you with your desired set up.

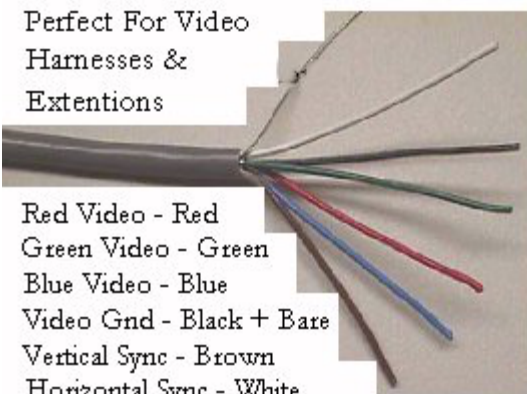


The on/off switch is a push on, push off switch & the momentary switch is the much larger 1/2" pushbutton, as well, rather than the typical mini switches.

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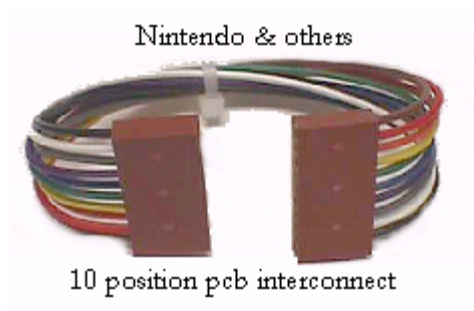
Perfect For Video
Harnesses &
Extentions



Red Video - Red
Green Video - Green
Blue Video - Blue
Video Gnd - Black + Bare
Vertical Sync - Brown
Horizontal Sync - White

Great For Volume Controls

Supershielded Multi Cable 6 Stranded + Gnd





3 1/8" Fan Guard



We double-side them & use them in the shipping area.
Cable ties do the trick very neatly.

fan4inch.jpg %d×%d pixels







**We double guard them here with cable ties
and use them at all work stations. Kool!**

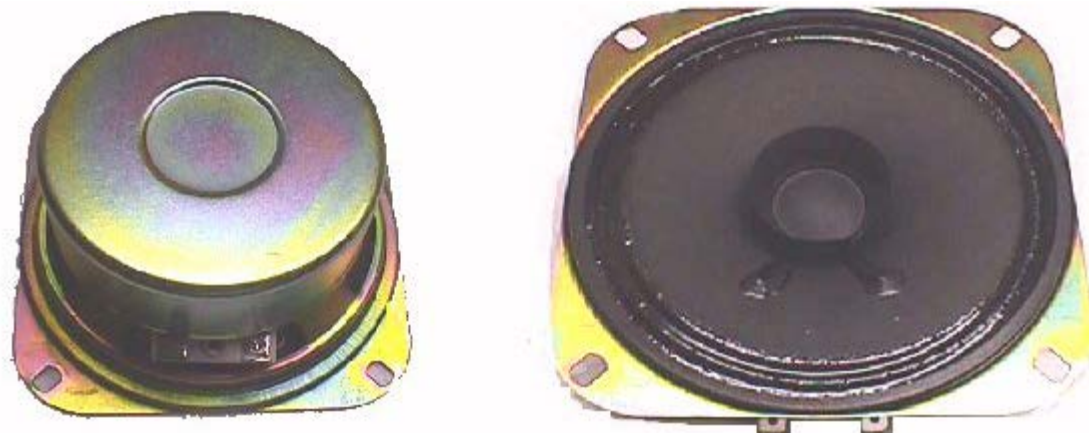




Complete With Grille & Mounting Hardware - Mount Up To 1.5" Thickness

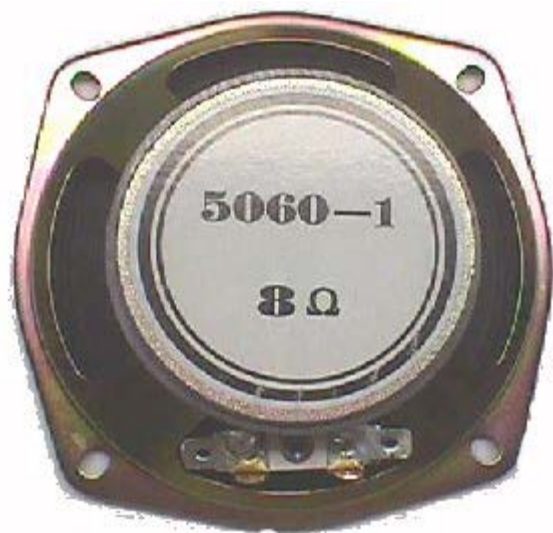


8 Ohm 50Watt Heavy Duty 7oz Magnet For Much Deeper Game Tones

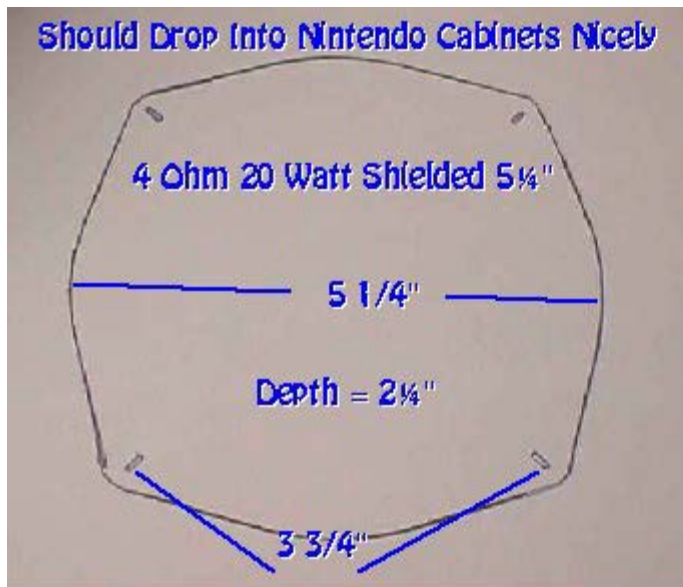


A better grade 4" shielded speaker... nice!

4" X 4" 6oz Magnet 8 Ohm 12 Watt











**This is a nice heavy duty speaker that sounds great
and won't blotch the pic on your screen like some do.
6" X 9" 12oz Magnet 8 Ohm 15 Watt**



JAMMA Harness Saga

by Bob Roberts

Update 3/11/2008

K... as many of you know already our harnesses have always been sold at a loss, but with several more wire increases due to the escalating copper prices... soon to overtake gold... we can no longer hold the price line. I'm embarrassed to say just how much we lose on wire & harnesses, but suffice it to say that the wire it takes to make a full JAMMA harness costs more than we charge for the completed harness at this time :-(We've held prices for you the past couple years after having to layoff one harness maker with the last increase we were forced to make after the 3rd wholesale price increase in a row, but now it is to the point of not being practical to even continue with harness making at all if we don't close the gap.

Since there are no other quality harnesses available for those who want them over the imports that are not worth the spaghetti they use to insulate them, and without labeling other than "Parts Side", we are going to attempt to keep making them with as little increases as possible. I know we could do away with labels, use cheaper imported connectors, pins, wire, reduce wire gauges to 22 & 24 and sparsely populate the connector with the bare minimum of wires to be competitive, but wait, those harnesses are already available at a huge number of places, so there would be no point!

I really hate to do this because I know there will be many hobbyist who cannot afford a quality harness or wire for their project, but I don't want to let this game cornerstone go by the wayside when I know it is an essential item on which to build.

My recent price hike on the JAMMA harnesses has generated the second largest email feedback since I've been here helping out, so I thought I would address this issue here for the sake of time. I guess I should just start from the beginning... as opposed to this last hike.

When I sold my mfr'g company in 1998 while in the process of retiring, I kept my own JAMMA harnesses out of the deal because I knew it was something that y'all could use. I sold them at a fraction of what it had cost me to build them as I was just trying to clear them out & had no intentions of being here at this time. Of course, those intentions were kicked to the curb along the way when the decision to stay on & help out was made.

Once my supply of harnesses was depleted everyone kept asking me to restock them. I didn't want to get back into harness making again due to the amount of time it takes, to say nothing of the wire, connector & pin inventory, so I went looking for ready mades. What I found was that all the major suppliers are selling basically the same imported harnesses that no one seemed to be satisfied with. Here's a pic of one.



Y'all were use to my harness with 18ga power wires & 20ga I/O wires with every position being labeled & populated with 5 feet of "real" wire... an ABC harness. With the one pic'd above... to keep costs down... they use all 22ga wire, populate only the basic needs & the "label" is only to distinguish the parts side from the solder side & is not a destinations label. They remind me of the ones that were used at the onset of JAMMA games with 4 amp switchers. Seemed like everyone in the industry was promoting heavier power supplies to correct all the game woes. You need a 5 amp PS... then it was you need a 7 amp PS... 10 amp... 12 amp... 15 amp :-(Well... I wasn't happy with those harnesses & began making my own with good "made in the USA" wire & using a gauge of wire that made more sense, rather than keeping costs down. What I found was that I could easily use the 4 amp switchers without a hitch and was using them long after other builders. I used them until they became hard to find & just always lagged behind using up each size supply as it, in turn, was blamed for the continuing game woes... all of which I had escaped. [I'll concede here that as time went on some boards did require a larger amp supply... Double Dragon being the 1st, as I recall.]

Needless to say, I was getting a lot of email about these imported harnesses which retail from \$15 to \$20, so I solicited bids from other harness makers using my specs. Good Lord! One bid was for \$35 per in lots of 500!@# The others were a tad better, but still way above the import's price :-(I got a couple leads on much cheaper harnesses, but they turned out to be either ones soldered to a PC tail connector, or ones that were still utilizing 22ga wire & even less populated, if you can believe that! Here's a pic of one of them:



They neglected to say that it was not populated for player 2 controls :-(This is about the time I caved & decided I had to make them in order to keep prices reasonable. Actually, I cannot fault them in their pricing & can see it is reasonable & most likely what I would have to charge for them if I were depending on them to make a living. Anyway, I ended up making harnesses again & one of the expense problems with doing JAMMA harnesses is that you really need to go to using a striped wire rather than trying to do a repeat solid color utilizing the 10 basic colors. You can get away with this on 18/36 & 22/44 harnesses, but when you're filling a 28/56 it can be hard to pinpoint any problems that might arise with that many repeated colors. Luckily, I found a supplier of this striped wire in precuts ready to roll, making it possible to hold the \$17 per harness price.

That pretty much brings us up to the recent price increases that started the email ball rolling. What's happened? How come they are so expensive now? What's going on with the harnesses? What are all the different harnesses for and numerous others, some I will never repeat :-()

What happened was that I lost my supplier of cheap striped precuts. I did not want to return to the inadequate harnesses still on the market today, and I could not go to paying the almost double price per foot for the same number of striped wires as I was using, so I opted for a compromise. I bought in another 100,000 feet of the 10 basic colors & had them stripe it. This not only increases the price of half the wire used in the harness, but I had to build a rack large enough to hold double the wire... which also means that I now have to maintain double the wire inventory. It's starting to seem like work, again :-(I'll have to send all this AARP mail back :-)



Yes... for every reel there is a like reel in the back row now with a stripe painted on the wire :-() Shipping? I can tell you that it is much cheaper to have a game shipped to me than a pallet of wire :-(The rack above weighs nearly as much as Alice's automobile!

As to why the harnesses are so expensive I can only tell you that they are about half of what I charged them off at in new game cabs & I really don't think they are expensive. Just do the math on components only from your favorite catalog....

- 1 Molex 28/56 Housing - \$3.05
- 1 Molex Key - \$0.65
- 54 Split Pins - \$9.72
- 1 Label - \$0.50
- 210' 20ga Import Wire - \$14.70
- 60' 18ga Import Wire - \$3.60
- Total - \$32.22

From the Parts Page...

- 1 Molex 28/56 Housing w/ Split Pins - \$6.00
- 1 Molex Key - \$0.50

- 1 Label - \$0.50
- 210' 20ga Wire - \$10.50
- 60' 18ga Wire - \$3.60
- Total - \$21.10

Hmmmm... I thought I was breaking even on the harnesses... looks like I'm paying for the privilege of building them :-)

Different harnesses? K... many were asking to have a label they supplied put on the JAMMA for their Neo Geo games. I've been told that the label was provided to them from the hardMVS.com site. Since so many wanted this label I just made it an optional way to get the harness on the Parts Page. Some people asked for the harnesses without being fully populated since they didn't need all positions filled, so in order to accommodate their needs & shave off the added \$3 cost for the new harnesses I eliminated the unwanted wires & cut the -5 volt & 12 volt lines to 20ga wire... *the "Economy" harness.*

Well... all the Qs should be answered even with all my interjected ramblings & hopefully it'll help you decide which harness you need.

[JAMMA Harnesses](http://www.therealboproberts.net/jamhar.html)



The Real Bob Roberts™

Economy JAMMA Harness Pinout & Colors

PARTS SIDE			SOLDER SIDE		
Black 18ga	Ground	1	A	Ground	Black 18ga
Black 18ga	Ground	2	B	Ground	Black 18ga
Red 18ga	+5 volts	3	C	+5 volts	Red 18ga
Red 18ga	+5 volts	4	D	+5 volts	Red 18ga
Blue	- 5 volts	5	E	- 5 volts	Blue
Orange	+12 volts	6	F	+12 volts	Orange
NA	Key	7	H	Key	NA
Yellow	Coin Counter 1	8	J	Coin Counter 2	Yellow/S
Empty		9	K		Empty
Violet	Speaker +	10	L	Speaker -	Violet/S
Empty		11	M		Empty
Red	Red Video	12	N	Green Video	Green
Blue	Blue Video	13	P	Composite Sync	White
Black	Video Ground	14	R	Service Switch	Orange/S
Red/S	Test	15	S		Empty
Brown	P1 Coin	16	T	P2 Coin	Brown/S
Gray	P1 Start	17	U	P2 Start	Gray/S
Blue	P1 UP	18	V	P2 Up	Blue/S
Green	P1 Down	19	W	P2 Down	Green/S
Yellow	P1 Left	20	X	P2 Left	Yellow/S
Red	P1 Right	21	Y	P2 Right	Red/S
Orange	P1 Button 1	22	Z	P2 Button 1	Orange/S
Violet	P1 Button 2	23	a	P2 Button 2	Violet/S
White	P1 Button 3	24	b	P2 Button 3	White/S
Empty		25	c		Empty
Empty		26	d		Empty
Black	Ground	27	e	Ground	Black
Black	Ground	28	f	Ground	Black

Outside Color=Bundle | /S=Striped

Yel=Power|Gray=Coin Door|Violet=Speaker|Green=Video

Pink=Player 1 | Aqua=Player 2

The Real Bob Roberts™

Neo Geo Pinout & Colors

PARTS SIDE			SOLDER SIDE			
Black 18ga	Ground	1	A	Ground	Black 18ga	
Black 18ga	Ground	2	B	Ground	Black 18ga	
Red 18ga	+5 volts	3	C	+5 volts	Red 18ga	
Red 18ga	+5 volts	4	D	+5 volts	Red 18ga	
Blue 18ga	- 5 volts	5	E	- 5 volts	Blue 18ga	
Orange 18ga	+12 volts	6	F	+12 volts	Orange 18ga	
NA	Key	7	H	Key	NA	
Yellow	Coin Counter 1	8	J	Coin Counter 2	Yellow/S	
Gray	Coin Lockout 1	9	K	Coin Lockout 2	Gray/S	
Violet	Speaker R +	10	L	Speaker L +	Violet/S	
Blue/S	Mono +	11	M	Test	Orange	
Red	Red Video	12	N	Green Video	Green	
Blue	Blue Video	13	P	Composite Sync	White	
Black	Video Ground	14	R	Service Switch	Orange/S	
Red/S	Coin 3	15	S	Coin 4	White/S	
Brown	Coin 1	16	T	Coin 2	Brown/S	
Gray	P1 Start	17	U	P2 Start	Gray/S	
Blue	P1 UP	18	V	P2 Up	Blue/S	
Green	P1 Down	19	W	P2 Down	Green/S	
Yellow	P1 Left	20	X	P2 Left	Yellow/S	
Red	P1 Right	21	Y	P2 Right	Red/S	
Orange	P1 Button A	22	Z	P2 Button A	Orange/S	
Violet	P1 Button B	23	a	P2 Button B	Violet/S	
White	P1 Button C	24	b	P2 Button C	White/S	
Green/S	P1 Button D	25	c	P2 Button D	Black/S	
Brown	Select Up	26	d	Select Down	Brown/S	
Black	Ground	27	e	Ground	Black	
Black	Ground	28	f	Ground	Black	

Outside Color=Bundle | /S=Striped

Yel=Power|Gray=Coin Door|Violet=Speaker|Green=Video

Pink=Player 1 | Aqua=Player 2

Just say no to a Super Harness!

A prepacked Super Harness comes with a 9 position Molex .093 connector in each player CP switch bundle and has the .187 QDs already attached to plug onto the microswitches of the joysticks & buttons. All other connections still have to be supplied and made up by you, so why not save enough to pay for all the connectors you need & do them yourself.

Super-Super Jamma Harness Kit

1 Economy Jamma Harness *
2 Molex .093 12 position connectors w pins & sockets
1 Bag of 50 .187 QDs fully insulated - CP & maybe spk
6 .250 QDs insulated - coin switches & maybe speaker
1 Amp 2 pos connector w pins & socs for speaker wires
1 Molex .156 IL 6 pos connector w pins monitor (vid)
1 Molex .156 IL 3 pos connector w pins monitor (sync)
1 10' black 22ga wire for switch ground loops
8 Spade connectors for power supply terminals
1 Amp 12 pos connector w pins & socs for coin door

All this for the same money and you'll have spare parts when you've finished custom building your cab's harness.

* Add \$4 to sub a Neo harness or a fully loaded harness.

The Real Bob Roberts

JAMMA Pinout & Colors

PARTS SIDE			SOLDER SIDE		
Black 18ga	Ground	1	A	Ground	Black 18ga
Black 18ga	Ground	2	B	Ground	Black 18ga
Red 18ga	+5 volts	3	C	+5 volts	Red 18ga
Red 18ga	+5 volts	4	D	+5 volts	Red 18ga
Yellow 18ga	- 5 volts	5	E	-5 volts	Yellow 18ga
Orange 18ga	+12 volts	6	F	+12 volts	Orange 18ga
NA	Key	7	H	Key	NA
Red/Green	Coin Counter 1	8	J	Coin Counter 2	Blue/Green
Green/Red	Coin Lockout	9	K	Coin Lockout	Blue/Red
Yellow/Red	Speaker +	10	L	Speaker -	Yellow/Green
White/Red	Not Used	11	M	Not Used	White/Green
Red/Black	Red Video	12	N	Green Video	Green/Black
Blue/Black	Blue Video	13	P	Composite Sync	White
White/Black	Video Ground	14	R	Service Switch	Orange/Black
Blue	Test	15	S	Tilt	Green
Red/Blue	P1 Coin	16	T	P2 Coin	Green/Blue
Red/White	P1 Start	17	U	P2 Start	Red/Yellow
Green/White	P1 UP	18	V	P2 Up	Green/Yellow
Blue/White	P1 Down	19	W	P2 Down	Blue/Yellow
Black/White	P1 Left	20	X	P2 Left	Black/Yellow
Violet/White	P1 Right	21	Y	P2 Right	Violet/Yellow
Brown/White	P1 Button 1	22	Z	P2 Button 1	Brown/Yellow
Yellow/White	P1 Button 2	23	a	P2 Button 2	White/Yellow
Orange/White	P1 Button 3	24	b	P2 Button 3	Orange/Yellow
Gray/White	P1 Button 4	25	c	P2 Button 4	Gray/Yellow
Yellow/Orange	P1 Button 5	26	d	P2 Button 5	Yellow/Black
Black	Ground	27	e	Ground	Black
Black	Ground	28	f	Ground	Black

The Real Bob Roberts™

MOLEX POLARIZING KEY

QTY	Price
1 - 4999	\$1.11
5000 - 9999	\$1.08
10000 - 24999	\$1.03
25000+	\$0.964

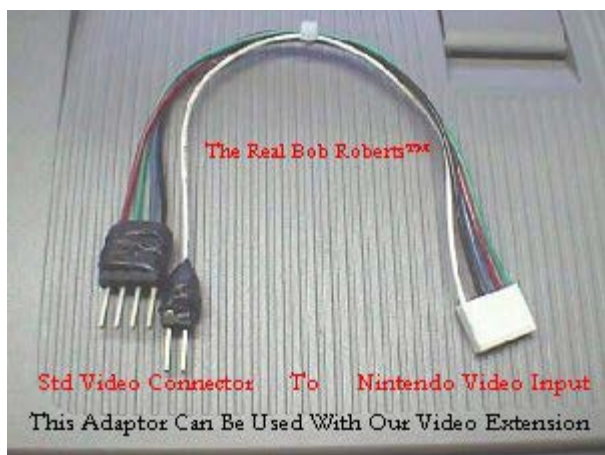
Sorry guys... had to restock these & they are double the price now!









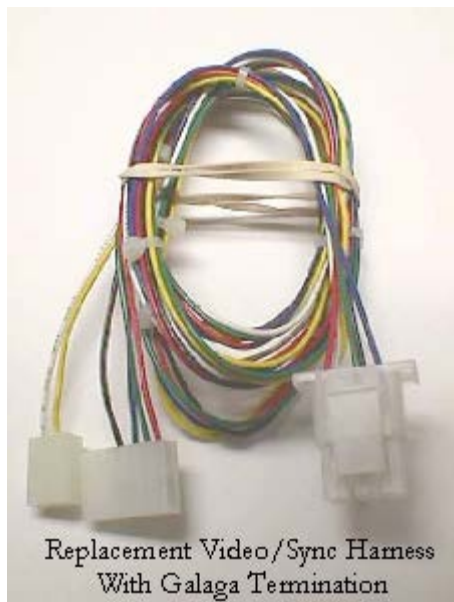


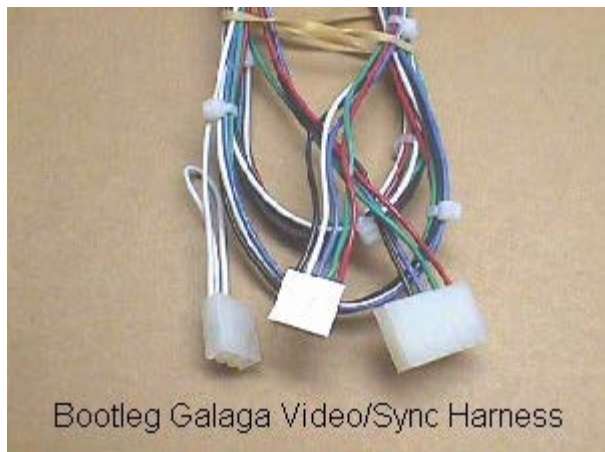


Replacement Video/Sync Harness

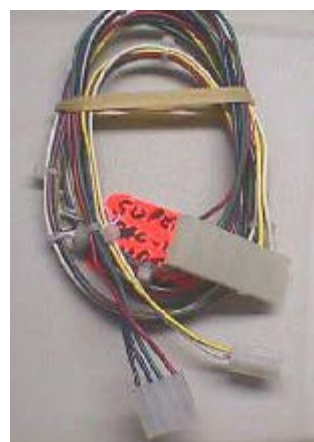


Replacement Video/Sync Harness
With Jamma Pin Termination

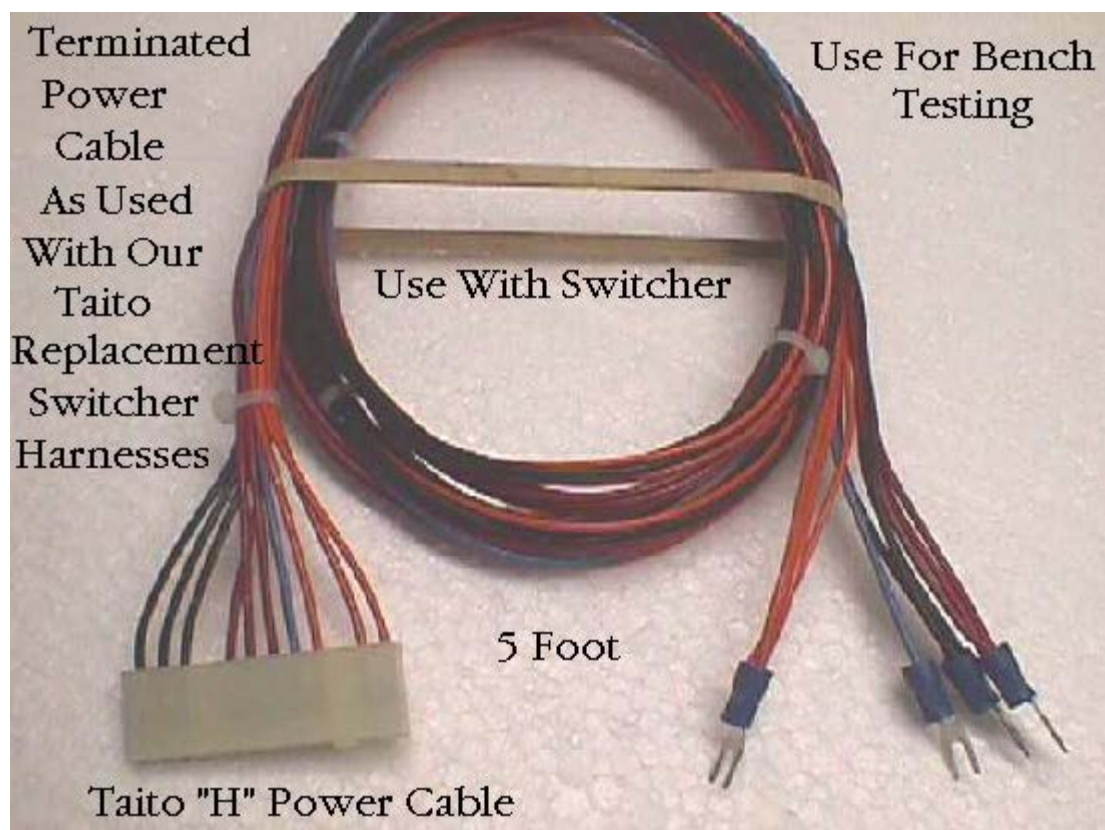




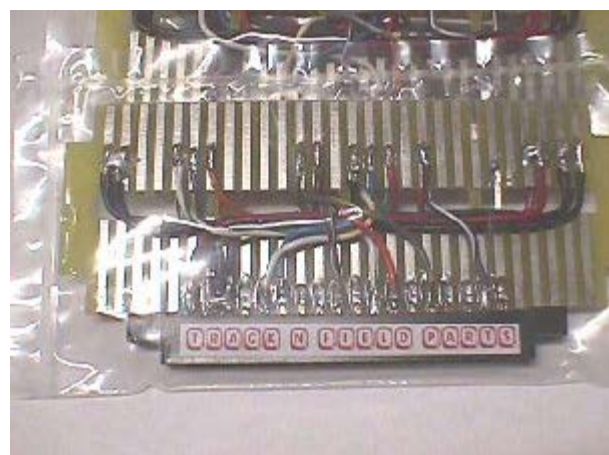
spm.jpg %d×%d pixels

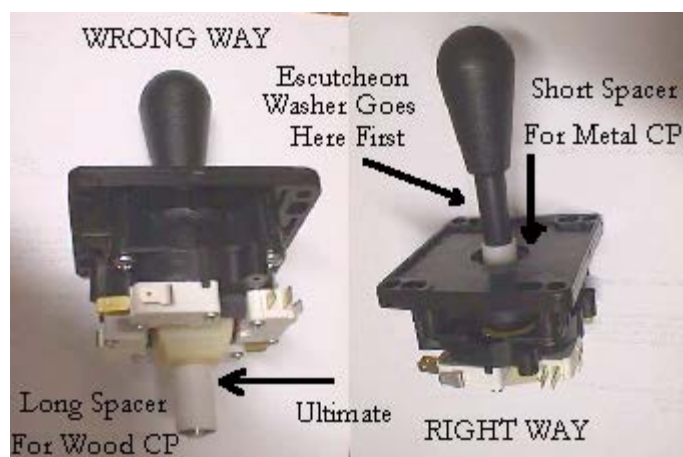








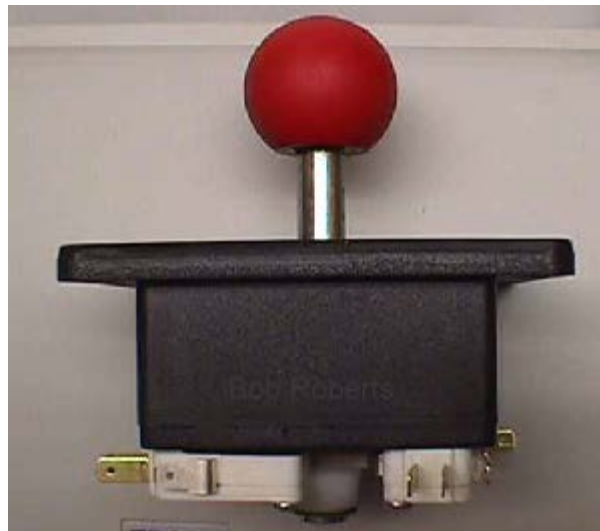




Red Ball Replacement Joystick

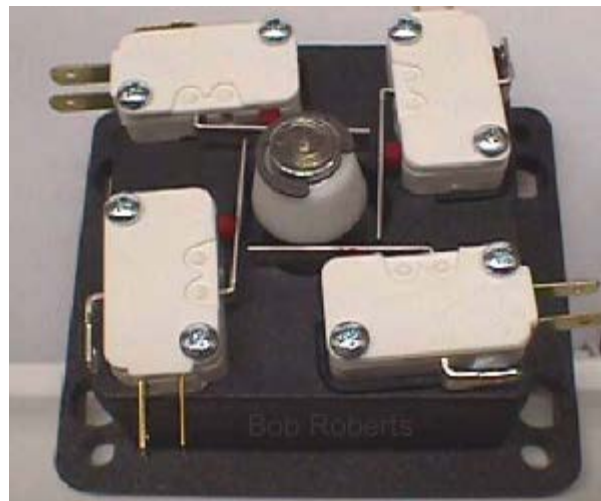
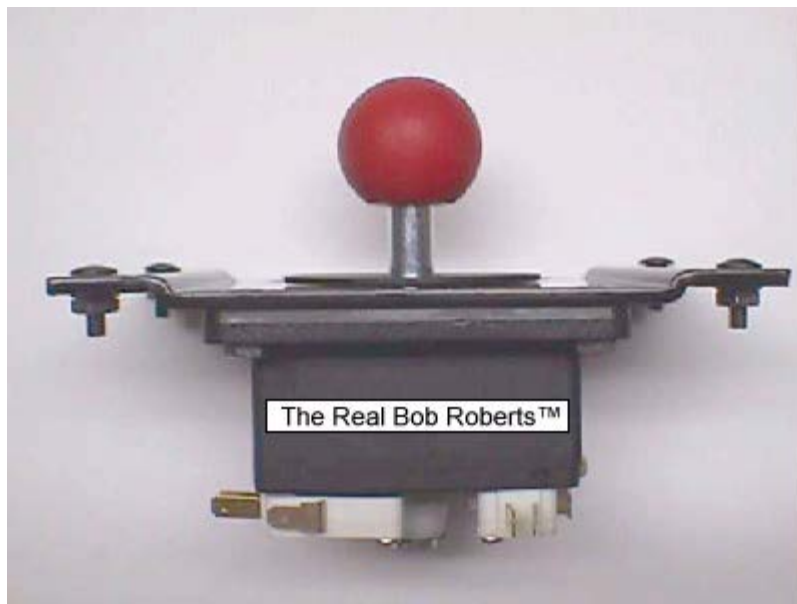


Here's Happ's latest joystick made to be used in the Namco 20 Year Reunion Ms Pac-Man/Galaga cabs, but I think they will workout great in other apps, as well. In this top view you can see it has the bolt pattern of the newer generation joys such as the Ultimate & other standard sticks. It is a 4-way stick, but with a smoother action due to the diamond cut-out, and has a fairly stiff spring back to center to it.



Here's the side view of the joysick and unless they know something that I'm unaware of, I don't see how you could possibly mount it in a wood control panel as is, short of mounting it down through the top, and that would require a pretty accurate square cut-out & the Cherry switches would have to come off & be reattached after mounting.

I have the adaptor plates to mount these to Pacs in stock now. They work perfectly & effortlessly & many are commenting that you don't even realize they are micros.



Here in the bottom view all you purists will see that it does use the Cherry microswitches with metal actuators... and, yes, it does go clickety, clackety as you use the stick, but I think that once mounted in an enclosed control panel, and the background sound of the game is on, you might even get use to it:) Perhaps it will click & clack to the games movements and enhance game play..... it could happen, right?

All things considered, I think this is going to be a nice addition to the Happ line, and benefit ops, collectors and MAMEers alike.



New Pac Adaptor Plates

Back To Old 1 Piece Style As Below

Powder Coated Black - With Mounting Hardware

Just The Adaptor Plate - ~~\$17.50~~ Now \$12.00

With Happ's New Microswitch Pac Joystick - \$30.00

Old units that sold out in June of 1999.



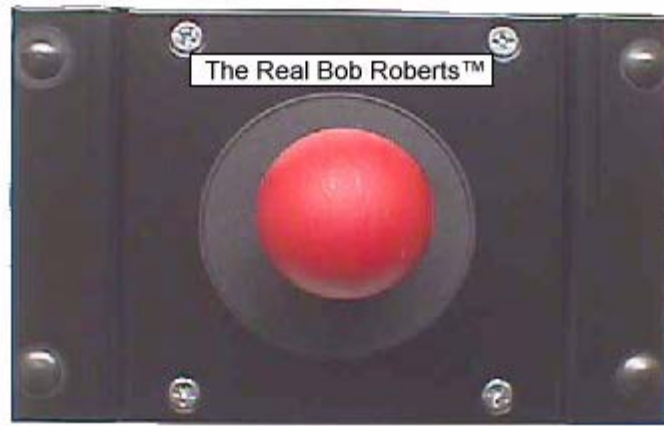
The redball microswitch joystick mounted on the adaptor plate.



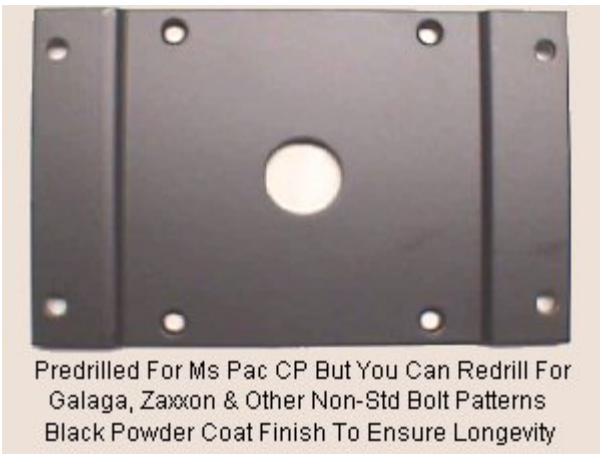


Redball joystick mounted on the new adaptor plate for 2002.





[To The Real Bob Roberts Site Index](http://www.therealbobroberts.net/pacadapt.html)





Joystick Centering Grommet



Since the NOS Pac grommets were at an age where dry rot was setting in I had a new batch made & they have arrived 6/12/2009... finally! Taking the advice of several gamers I had them made a little stiffer for a quicker return to center & a better feel when in use.

One of the welcomed benefits is after all expenses were covered we've lowered the cost to \$10 each.

Lasted for a couple years... new batch 12/1/11 with new price of \$11 each.

spring.gif %d×%d pixels



grip.jpg %d×%d pixels



plugs.jpg %d×%d pixels













I detest these convex buttons with a passion... as so many others do... but there is a small click of people that really, really like them & have been after me for years to stock them, so I'm going to offer them on a trial basis. I'll list them separately on this page for copy & pasting.

Happ Competition Pushbutton Red	\$1.50
Happ Competition Pushbutton White	\$1.50
Happ Competition Pushbutton Blue	\$1.50
Happ Competition Pushbutton Purple	\$1.50
Happ Competition Pushbutton Yellow	\$1.50
Happ Competition Pushbutton Green	\$1.50
Happ Competition Pushbutton Black	\$1.50

micro.gif %d×%d pixels





These are Cherry switches with less tension & therefore less noise. They omit the unneeded NC terminal and when scope tested they show a very quick & sharp response. Seems to solve many hobbyist complaints of the clackety-clack noise along with a better reponse, so we decided to give them a shot.

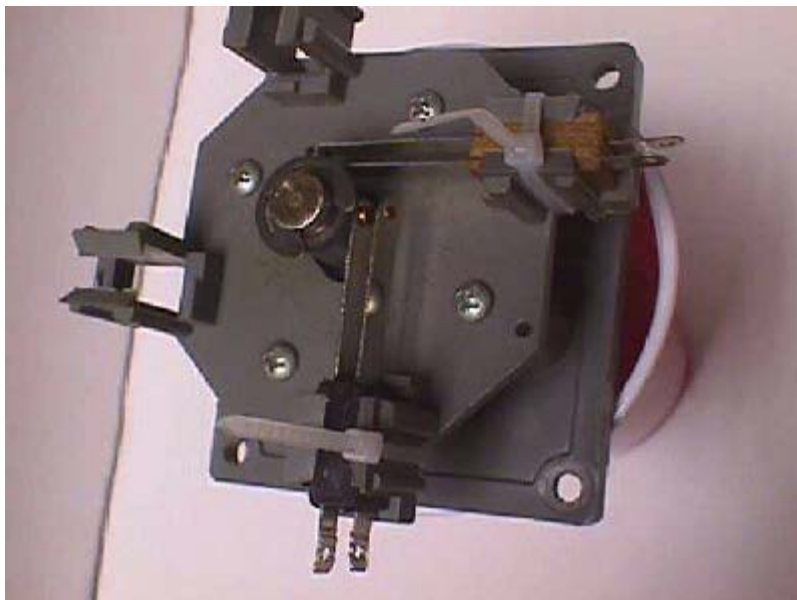




joyleaf.jpg %d x %d pixels





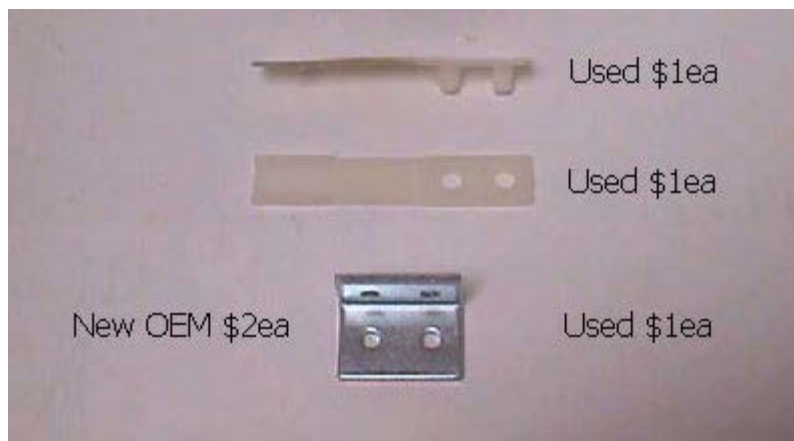


When replacing the obsolete Wico leaf switches with repro's, if any are still floating around out there, you need to cable tie them in place for secure operation. You can leave the excess, but it's always neater to snip the ends off. You can use the OEM used switches without the plastic insulator by cable tying, as well.... or even with the insulators if your mounts have loosened up over the years.

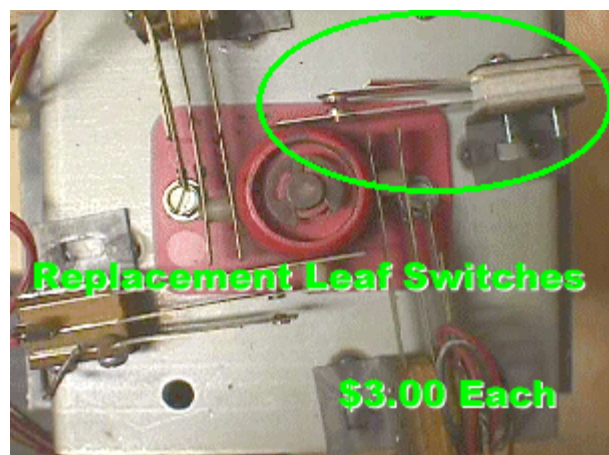
The switch in the upper part of the pic above is a fiber switch that we make here. They are a much better quality switch & should last a long time, but they need to be secured in place, also.



This is another of the various Wico joys & this one uses an "L" bracket to mount in place. These can mount with or without the insulators, too, and the fiber joy switches we make can be used as a replacement.



These are a handful of pieces that we recently aquired from a retiring local op that will be available until gone.













August 2006

I have purchased a couple more large lots of NOS leaf button stashes, along with a smaller topping off, which were added to our current inventory. The buttons have been bought in over the years at various prices up to \$3 each in some deals and when I added a large lot 2 years ago I cost averaged them with inventory present at that time, bringing the price down once again to a new low of an average \$1.50 per button.

Well... all the new purchases have been clumped in with our present inventory & cost averaged down to a new low, once more, of an average \$1 per button.

Happy Gaming....





whtbut2.jpg %d×%d pixels









I must be crazy... just stumbled onto another huge stash of the old e-clip type short leaf buttons & I bought them... like I need more! They are now available onsite at \$1 each & are all of the same mold & go together nicely.

Colors available are:

Green Apple - Candy Apple Red - ~~Pure White~~
~~Midnight Black~~ ----- Midas Gold

Pal Nuts Needed & Sold Separately 5/\$1

The Real Bob Roberts™





These new leaf switch holders have heavy duty leaf switches with gold flashed contacts for longevity. They should NEVER be filed or sanded! If they should

become blackened & you want to clean them, you can clean them with an ordinary business card, a folded piece of white copy paper or an eraser. A business card seems to work the best. Simply place it between the contacts, depress the button & slide the card back & fourth.

The Real Bob Roberts™



So many have requested the leaf switch holders that were discontinued that Alice & I decided to turn a CD into a huge batch of these & coaxed a long time friend out of retirement to make a run of them for us.. They only cost us a few cents more in the large quantity, so we'll be able to hold the price.

Taking Care Of The New Leaf Switches



These new leaf switch holders have heavy duty leaf switches with gold flashed contacts for longevity. They should NEVER be filed or sanded! If they should

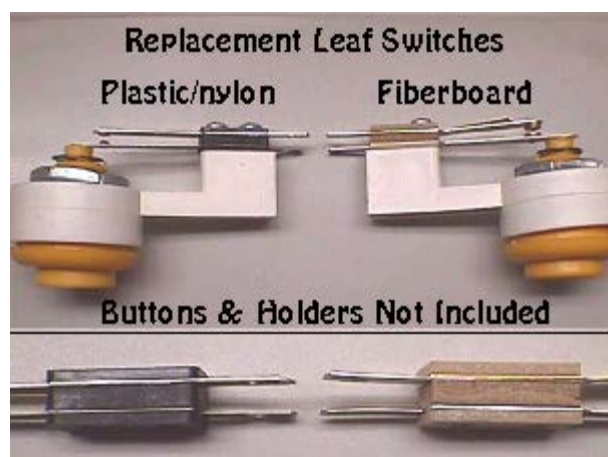
become blackened & you want to clean them, you can clean them with an ordinary business card, a folded piece of white copy paper or an eraser. A business card seems to work the best. Simply place it between the contacts, depress the button & slide the card back & fourth.

The Real Bob Roberts™

















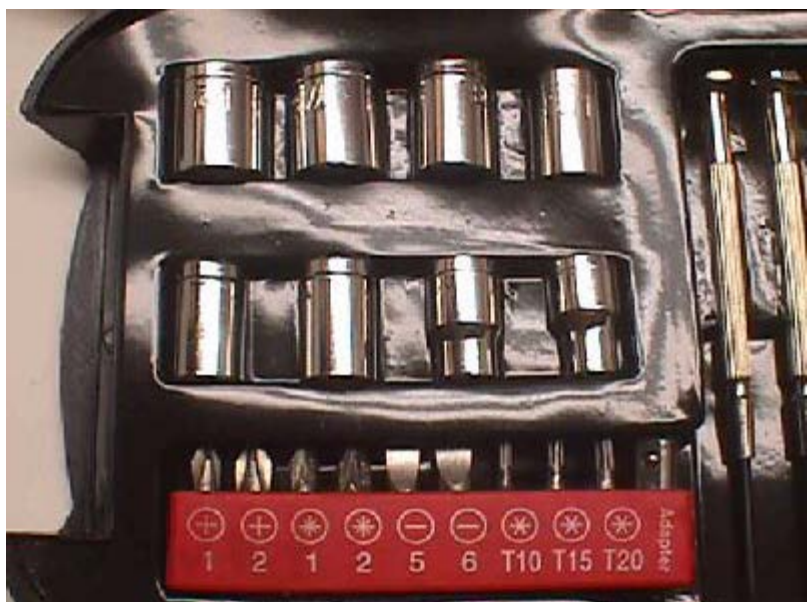






Flashlight-Tool Kit







For the past 6 years y'all have been beating me up over discontinuing the SafeBack dischargers. I've heard begging, bribing & cussing. I know I've said not to use a Craftsman or other case hardened screwdriver hundreds of times, and still I hear things like I broke 6 drill bits trying to drill that hole. The second most heard complaint is that you're unable to find all the parts reasonably priced. Coming in third is... I don't have a grinder!

Y'all win! I've bought in the parts necessary to build the SafeBack & found someone to do the drilling & grinding for you & will offer it as a kit for 2008.

Assembly should be easy using the [SafeBack Page](#) & should look something like this when you're finished.

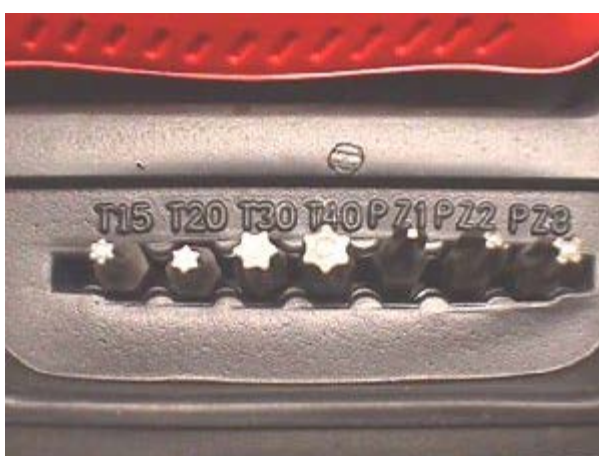


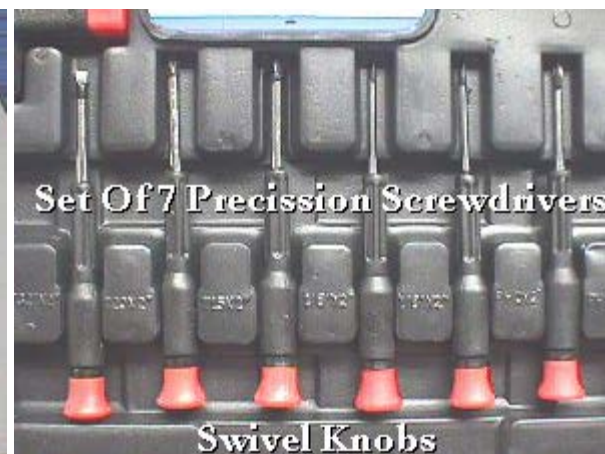
Happy Gaming...





Screwdriver Kit













Cable Tie Tool



Out of the nearly one hundred cable tie tools we have tried this one is the one that our harness maker endorses. I'm told if you set the tension to "4" it'll tighten 4" cable ties at a perfect tension, automatically cut it & hold the spew until you release the trigger. That allows you to hold it over a trash can or bucket & drop those remnants right in with no mess to clean up.

[Site Index](#) - [Big Bear's Bulletin Board](#) - [Parts Page](#)



Metal With
Plastic Handles



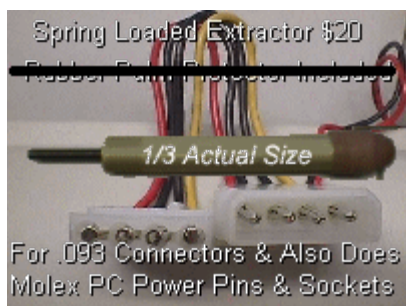












ampext.jpg %d×%d pixels

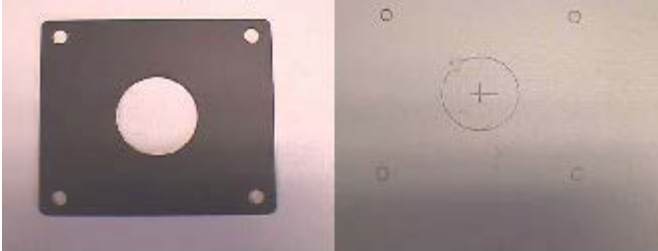


xtractor.jpg %d×%d pixels





Exact Steel Template



Other Uses

Corral Your Game Keys
Joystick Shim/Stiffener
Pushbutton Mount



Test Switch Mount



hook.jpg %d×%d pixels





\$5.00

A Must Have - I Won't Work Till I Have Mine!



HT-1921 Crimper



Sixteen years I've been hearing this in email on an almost daily basis, "I don't need the crimpers, I have a pair already." No matter how many times I explain the difference it always ends up the same way. The connectors and/or pins & socs ship out & 3 to 4 days later comes the email of, "I need to order those HT-1921 crimpers."

There is a big difference in these crimpers with the anvils to crimp pins & socs and the \$3 automotive crimpers without anvils. They are designed to crimp insulated connectors used in the automobile industry, although these days even the automobile industry needs the anvil type crimpers for newer connectors & computer connections.

The HT-1921 crimpers have anvils that allow you to crimp .062, .084, .093, .100, .156 & etc, while also doing all the insulated terminals & have a wire stripper & bolt cutter built in to boot.

There are crimpers on the market priced into the hundreds of dollars, but most have detachable anvils or are a ratchet type said to be easier, but are so cumbersome that they slow you down to a crawl when using them to do more than a few pins. Our harness makers times were doubled & tripled when trying to use these types & they complained of their hands aching, so they were not practical in production.... only used in service caddies for small location repairs. If the service caddy had the HT-1921 it would be the chosen one over the ratchet type every time.







ssd.jpg %d×%d pixels



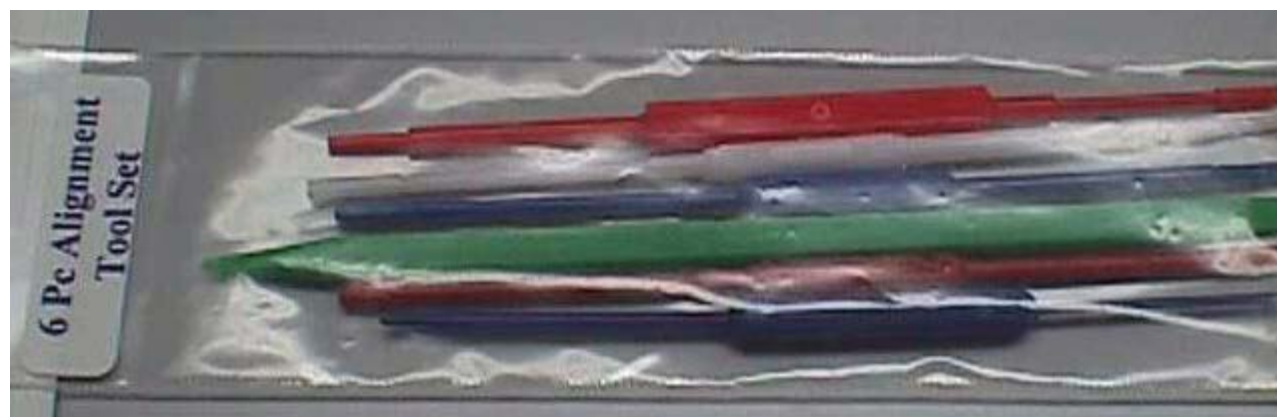















16" Non-conductive Adjustment Tool

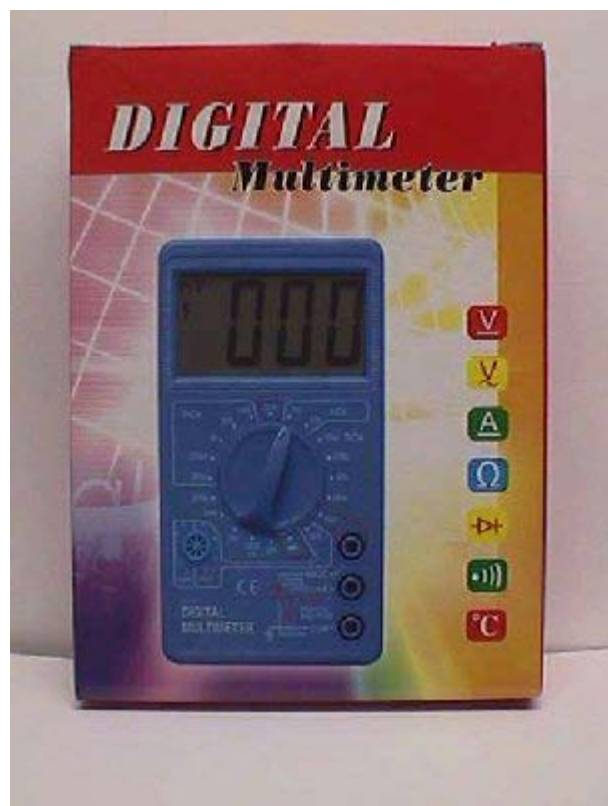
Great for adjusting H centering on the K4600

H hold on the Sanyo 20EZ monitor or any
place near HV or otherwise hard to get to.



It took 5 months to get them mfr'd, but they are here now!





1 1/8" Step Drill

Drill thru

Wood

Metal

Plexi

All at the

same

time

if you

want.

Slow

only on

stainless

steel !!

No Used Left ch

Current price

\$67.00

2 Left In Stock

At \$50.00 Each

2011

CP button hole size

No starter holes

needed!

> Flat cutting

edges!

< Sharpen with Dremel

> & stone

bit.

< Turn a 7/8"

> hole into

a 1 1/8"

hole

with ease

Enlarge

Nintendo button

holes to standard

size button holes!

Very

limited supply.

The Real Bob Roberts™

1/2" shank



http://www.therealbobroberts.net/step_drill.jpg[12/17/2016 6:46:23 AM]

Indispensable 170 5" Flushcutters



KO
Plato
\$6.00



Import
\$5.00



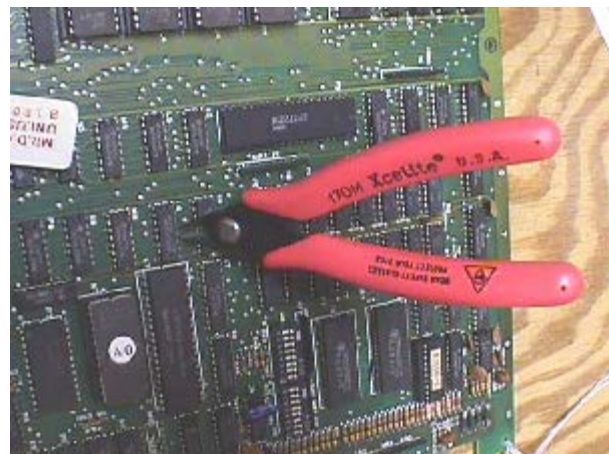
Duratool
\$5.00



Xcelite
\$7.00

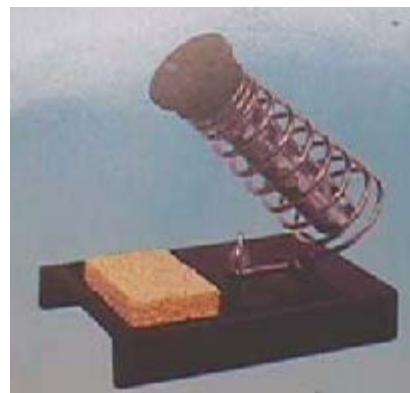
The Real Bob Roberts™









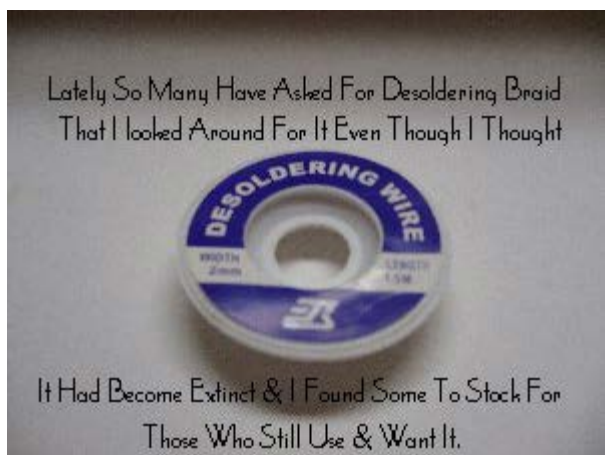






Many of you newbies have been asking for a cheap soldering kit saying that you only intend to do a monitor cap kit job or some other minor soldering job and it may never be used again! Some of you just don't know if you are adept at soldering & don't want to lay out the big bucks to find out, so you are looking for something cheap enough to take a stab at it & find out. Well.. I scouted around and found these things to make up an inexpensive & disposable soldering kit & if it helps out I'll see if I can't keep them in stock.







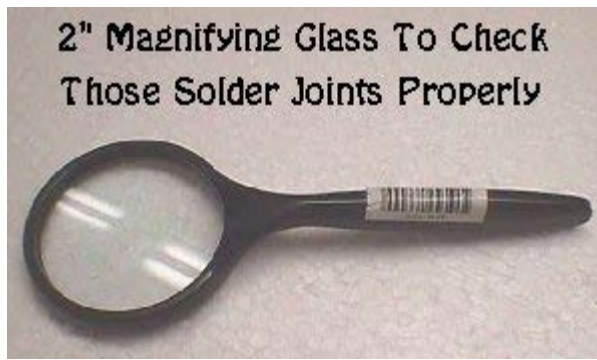


irontips.jpg %d×%d pixels





Tom pointed these out to me and asked if I would stock a few for monitor work & I said I would. It's a 2"x4.5" metal mirror that fits the palm of your hand to aid in adjusting monitors in their final resting spot. You could probably mount one in the front inside cab for a permanent aid with future adjustments as needed.





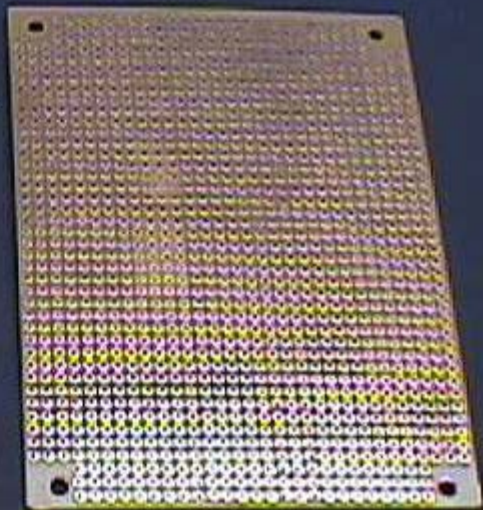
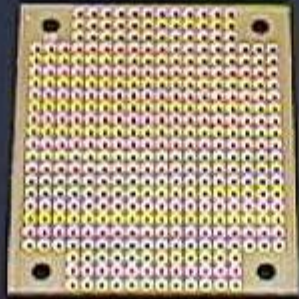
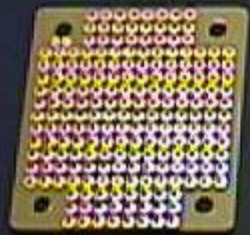


Prototype Boards

1 3/4" x 1 1/2"

3 1/8" x 4 5/16" >>>

2 5/16" x 1 15/16"









pacbolts.gif %d×%d pixels



You can use these yellow 8-32x1 1/8" carriage bolts as is for mounting the joystick on a Pac-Man, Galaxian or other metal CPs that were wood backed. As with any carriage bolts, you can spray paint the heads black if you want.



To spray paint the heads you simply push the carriage bolts through a piece of Styrofoam & prop it up outside, preferably, and spray paint them.



It's best to spray 4 or 5 thin, misty coats allowing 10 minutes, or so, between coats building up a durable, long lasting coat of paint. Allow to cure 24 to 36 hours for an even harder coat.



The best paint I found for this or coin doors, metal marquee retainers, and other black metal, even in just touching up, is

Krylon Semi Flat Black.

\$4.00 Per Set Of 10



Bolts Replace Lengths
Up To 1 1/2" Long
Cut To Fit Your App
Or Leave Excess

Located Some Of The Small 8-32 Carriage Bolts With No Foundry Stamp
That Many Have Requested. I sent Half Of The Shiny Bolts Out To Be
Black Oxidized. Either Set Of Ten Come With 10 Matching Kep Nuts.



\$5.00 Per Set Of 10



Finally located some stainless 10-24x1 1/4 imports without the raised foundry imprints... these are smooth, shiny heads & come with SS lock nuts.

I've had a gazillion requests for smooth head black carriage bolts over the past thirteen years and every where I turned I was told that all carriage bolts have the foundry stamp on the heads. A few years ago I managed to find a source for stainless imports with no foundry stamps & since I've never been able to locate the black oxide ones we decided to send out a batch of the ones we have to be blackened. They are back now & ready to be shipped. It's an expensive ordeal, but it's what y'all have been requesting over the years.



Sold in packs of 10 black oxide carriage bolts 3/16" x 1 1/4" with 10 black oxide keps for \$4.00.











Updated 2/05/2009

Miscellaneous Hardware	
Flat Head Phillips #4 x 7/16"	\$1.00
Flat Head Phillips 6/32 x 1/2"	\$1.00
Flat Head Phillips 6/32 x 3/4"	\$1.00
Flat Head Phillips 6/32 x 1"	\$1.00
Flat Head Phillips 6/32 x 1 1/2"	\$1.00
6-32 Nuts	\$1.00
Pan Head Phillips #4 x 3/8"	\$1.00
Pan Head Phillips 3mm x 1 1/4"	\$1.00
1/4-20 x 1 1/2" Carriage Bolt	\$1.00
1/4-20 Kep Nuts	\$1.00
Truss Head Phillips #2 x 3/8"	\$1.00
Truss Head Phillips #2 x 3/16"	\$1.00
10-24 x 1 1/4" Carriage Bolt	\$1.00
10-24 x 3" Carriage Bolt	\$1.00
10-24 Hex Nut	\$1.00
Nylon Pan Head Slotted 6-32 x 1/2"	\$1.00
Nylon Nuts 6-32	\$1.00

Happy Gaming.....

[Back To Parts Page](#)

[Site Index](#)











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course.jpg %d x %d pixels









to220.gif %d×%d pixels



























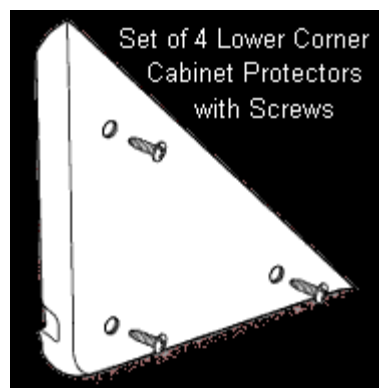
legs.jpg %d×%d pixels





**Set Of 4
Heavy Duty With Welded Nuts
2¾" Square
5/16" Holes**

The Real Bob Roberts™







anchor.jpg %d×%d pixels





keyhook.jpg %d×%d pixels















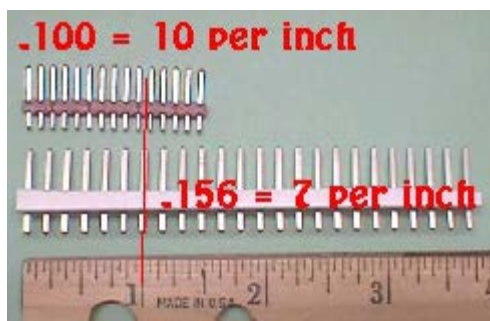










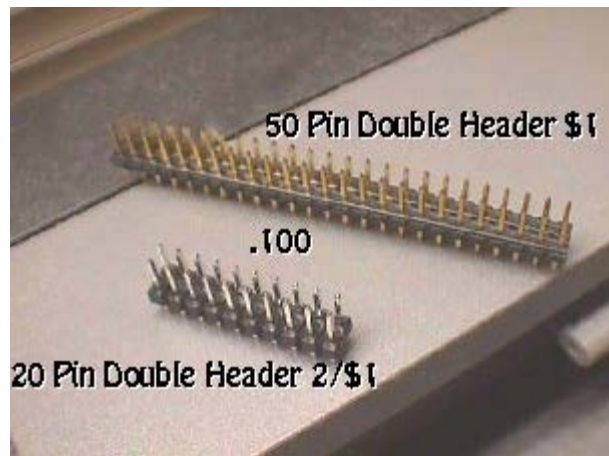


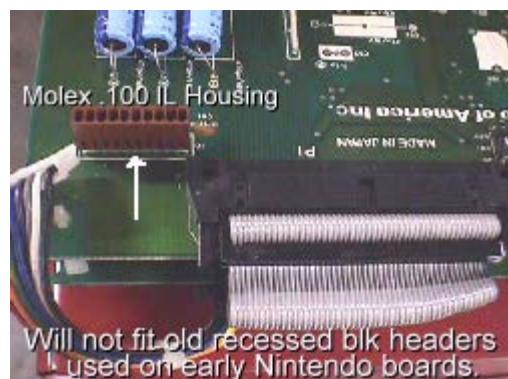


40 Pin Snap Off Gold-Plated .100 Right Angle Header

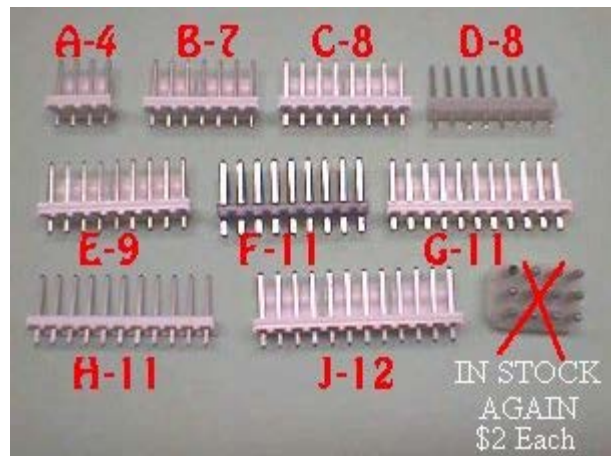












24 Position Break-away Right Angle Header

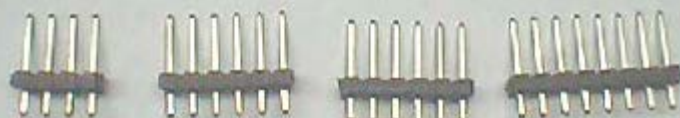


.156 Spacing

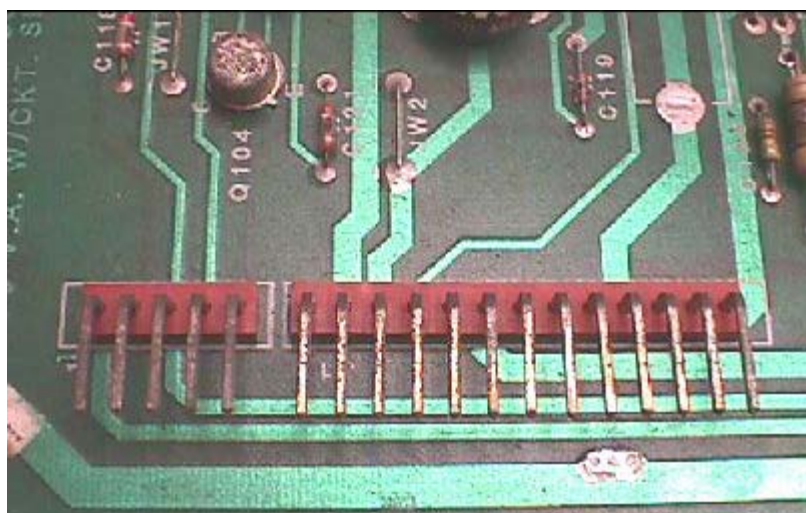
24 Position Break-away Right Straight Header



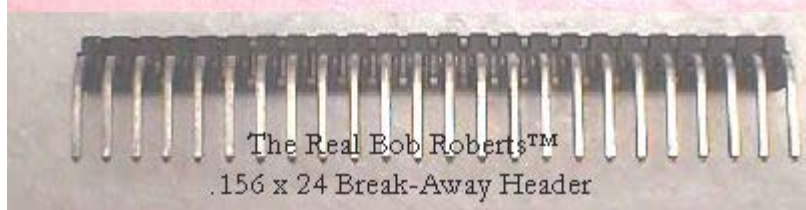
1 24 Position Will Make Multiple Smaller Headers



These Are Ramp Free To Save Your Solder Joints
Snip Or Pull A Pin For Key Positions



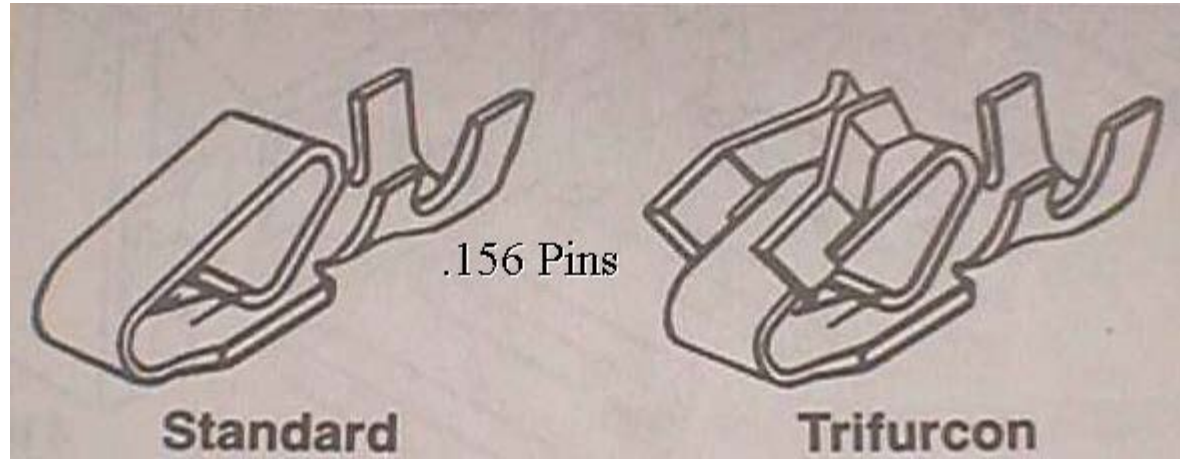
Do Your Headers Look Like These? Here's The Answer.







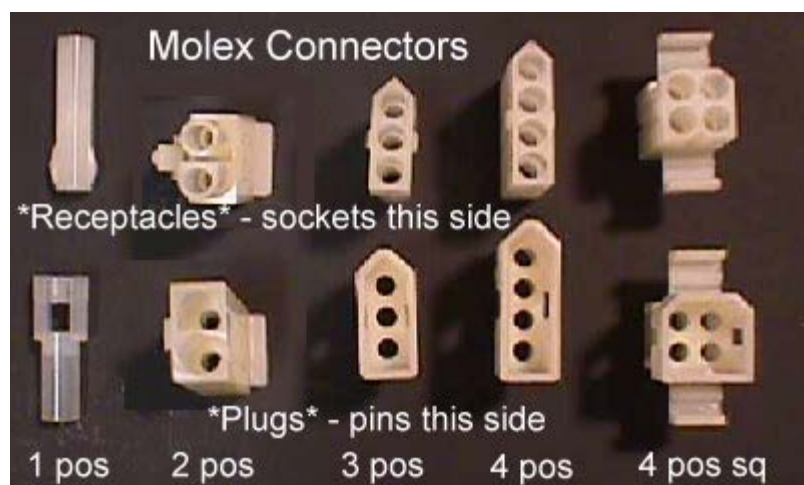








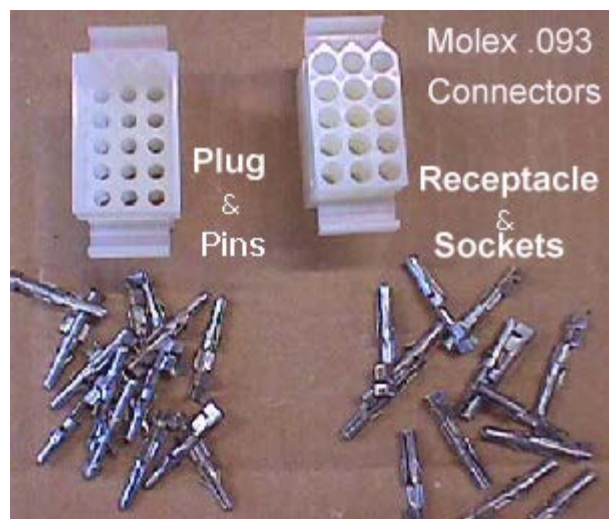






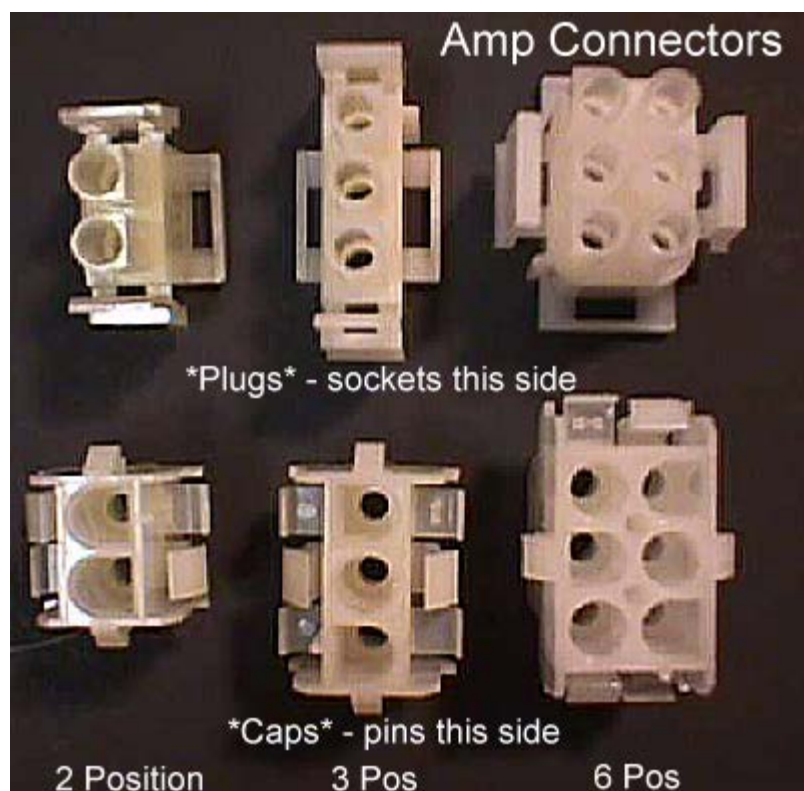
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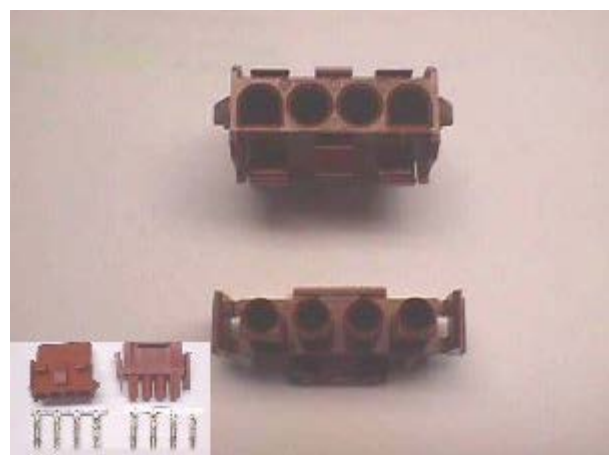


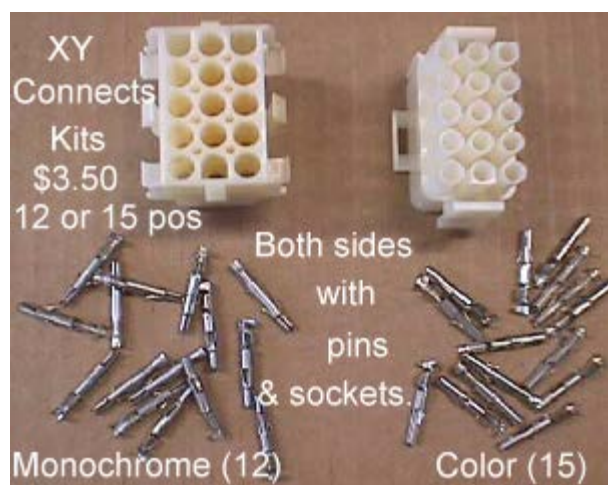


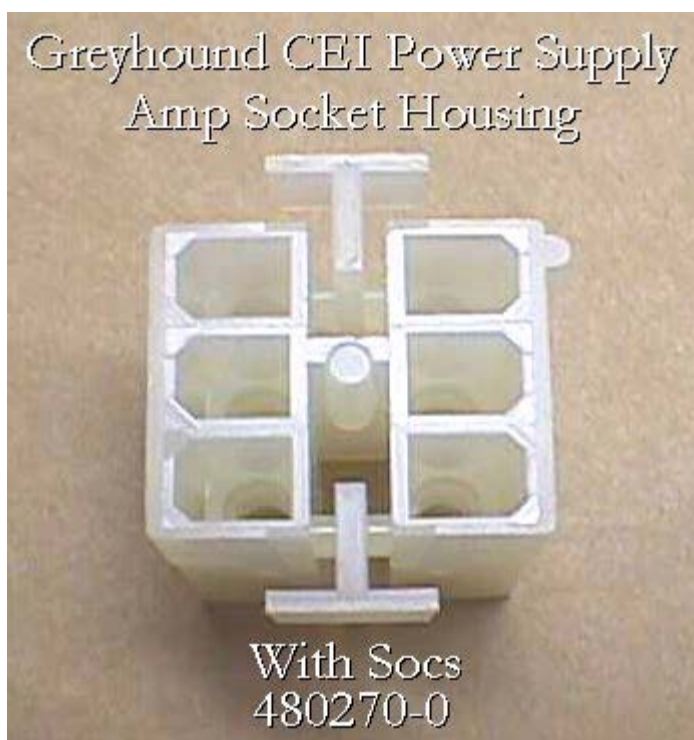






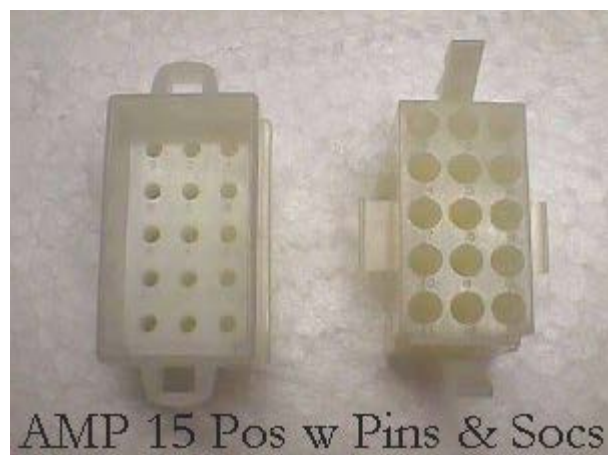




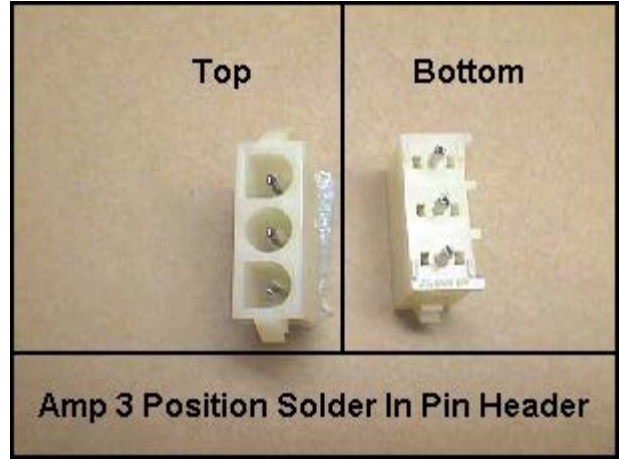


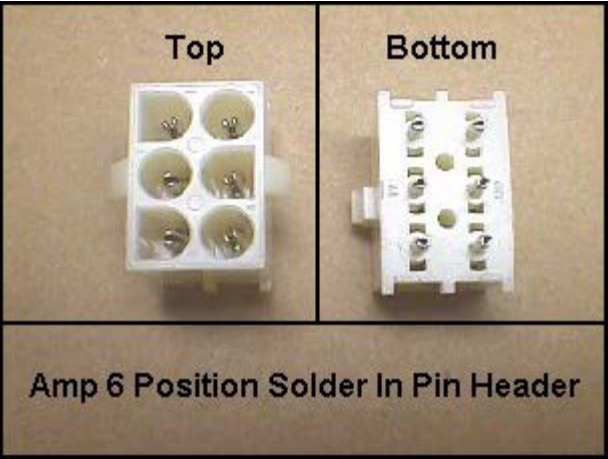


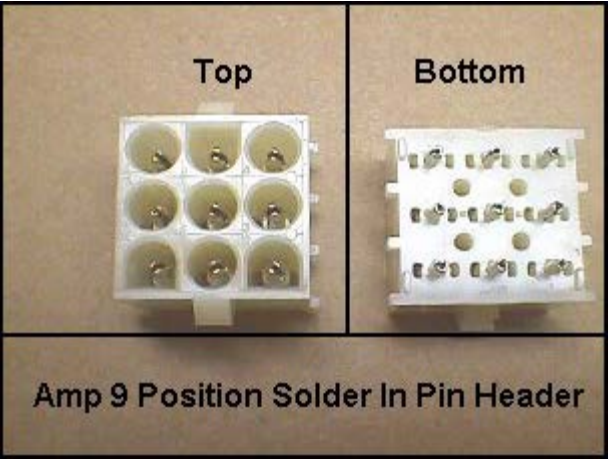


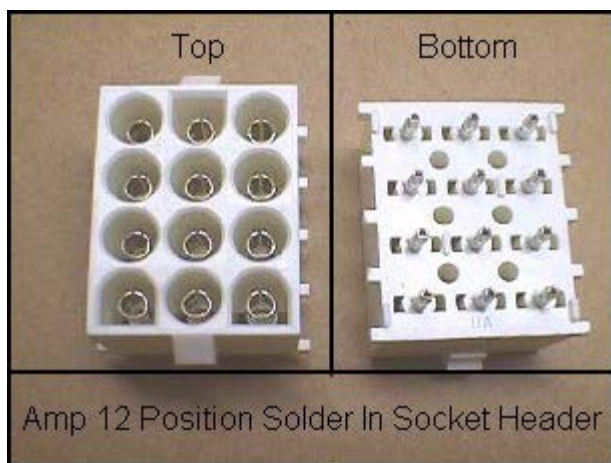


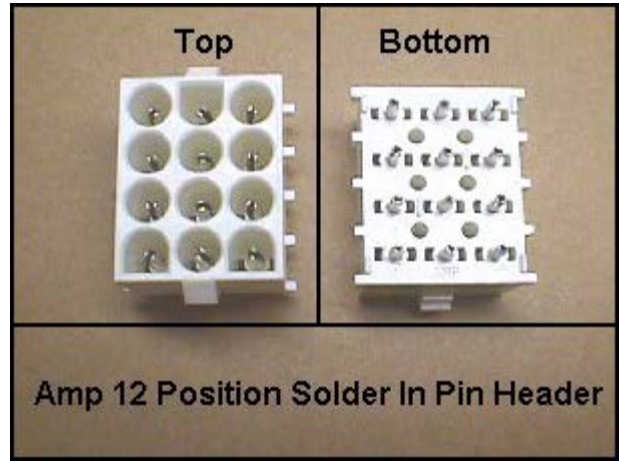


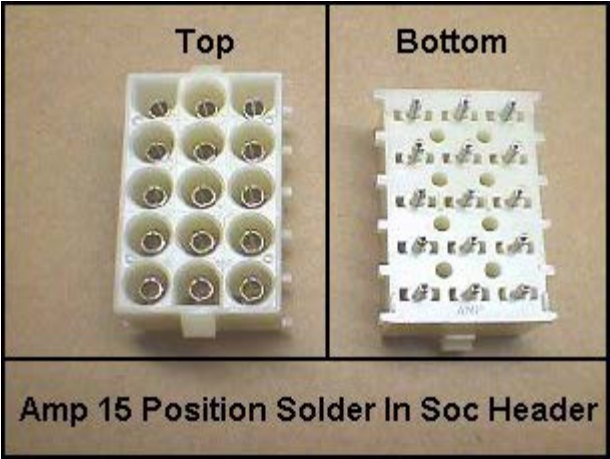


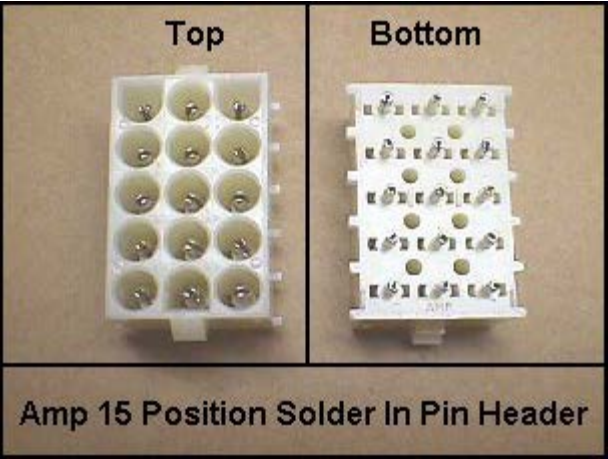










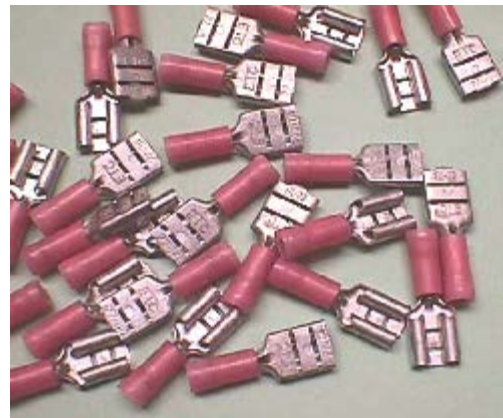


Amp 15 Position Solder In Pin Header

Red Quick Splicers 22-16		.110 QDs 22-16	.187 QDs 22-16				
.25 QDs 22-16	.187 QDs Insulated 22-16	.25 QDs Insulated 22-16	.187 QDs Insulated 16-14				
#8 Spades 16-14	#10 Rings 16-14	Blue Quick Splicers 16-14					







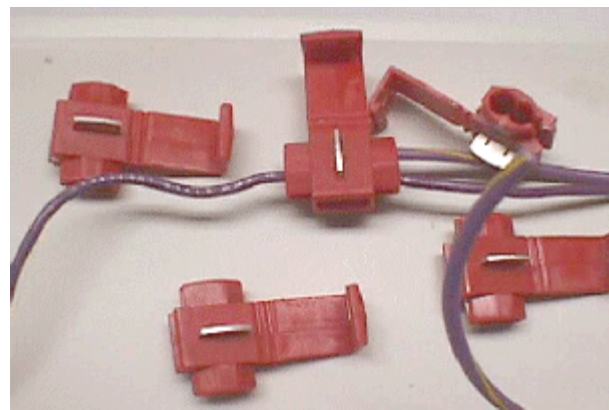






spadecon.jpg %d x %d pixels







crimpnut.gif %d×%d pixels













1000 Natural Ties + Tie Tool



2x Cable Clamps Bag of 100 1/8" - \$10.00
2x Cable Clamps Bag of 100 3/16" - \$10.00
2x Cable Clamps Bag of 100 1/4" - \$10.00
1x Cable Clamps Bag of 100 5/16" - \$5.00
1x 4" Cable Ties Bag of 1000 Natural - \$10.00

Total Regular Price \$45.00

Bob's Builder Pack Price \$35.00

Add A Cable Tie Tool For Just \$2.50 More.





Discontinued Split Pins

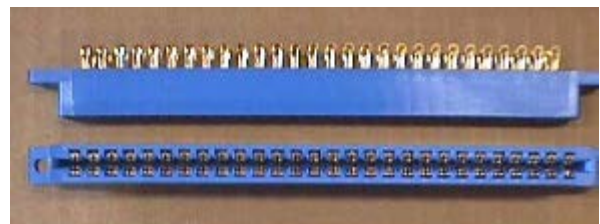


Since these Molex split pins were discontinued the price has been going up & they have been getting harder to find. To make sure that we would have plenty on hand for your projects I hunted down the last 100,000 case of them that I could find at a reasonable enough price to supply your needs without raising prices to you through the roof.

[Site Index](#) - [Big Bear's Bulletin Board](#) - [Parts Page](#)







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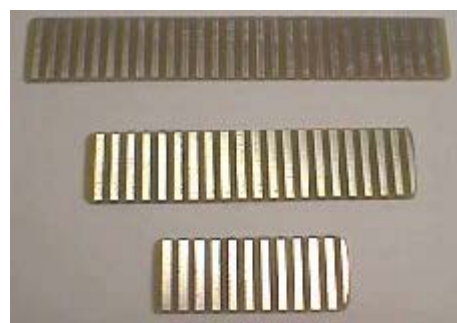




Type 1 Fingerboard - Solder Direct To Pads



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Std color pack contains 10' of each color code listed below.

blk-wht
wht-blk
gry-wht
brn-wht
orn-wht
red-wht
yel-wht
pur-wht
grn-wht
blu-wht

Scrap Wire

We sell so many scrap wire kits for adaptor building that we couldn't keep up with actual scraps, so we now cut pieces from the rolls. We went long to be sure you had enough to make any adaptor you may need giving you 20 feet of wire at 2005 pricing. A list of what you get is below.

- 18 Gauge
 - Red - 2'
 - Black - 2'
 - Orange - 1'
- 20 Gauge 18 Inches Each
 - Red
 - Green
 - Blue
 - Yellow
 - Violet
 - Brown
 - Gray
 - Black
 - Orange
 - White

Horizontal Width

By Bob Roberts



Polypropylene capacitors are used in most monitor width circuits & changing the value of capacitance up or down on a particular one will effect your pic's horizontal size range that is controlled by the width coil. I will list some of the common chassis "width" cap positions, but you can generally find this cap going to ground off one leg of the width coil itself. As a general ROT these caps will fall in a range from .1uf to .56uf - .1uf being widest & .56uf being narrowest in pic range - and usually at 200 working volts. Note: In some cases this narrow-wider range will be just the opposite due to the surrounding circuitry.

K.... Why do you need to know this? Let's say you just changed out a monitor in a game with another used monitor that you know was working fine in game XYZ, but after you fired it up in it's new home you found that adjusting your width coil from one extreme to the other just would not give you the needed range to either fill the screen, or vice versa, at it's minimum the pic was still so far over the screen that you could not see your "High Score" line :-((For a player, we all know that is not acceptable :-) The game PCB output is really at fault... well, not a fault necessarily, as it probably filled the pic perfectly on the particular model of monitor that it was shipped from the factory with, but the transplant needs something more & the monitor chassis is the most prudent thing to modify.

I should mention here that the monitor should be recapped, if not recently done, before modifying this circuit to be sure that some electrolytic cap is not at fault for your situation, which would cause it to be even further off the wall at some later point after a recap if you corrected with a polypropylene (PP) cap at this juncture :-)

Note: The width coil does not need to be taken all the way to the top or all the way to the bottom when adjusting. Most width coils have a very short span in which you will go from widest to narrowest range and if pressed will go through a second similar range. When adjusting you should not need to go more than 3 turns in either direction from the starting point. Trying to force this to the top or bottom may cause the ferrite core to crack.

K... As many of you know, I had width cap kits on the [Cap Kit Page](#) previously & I found that most did not know what to do with them once they had them, and that the ones that did know, did not like the orange drop PP caps, which are more tubular & cumbersome to work with. I ordered in "brownies" to make up new width cap kits, but have been holding off on posting them until I can get this Page done. Now that you know about this width cap I'll try to answer a few Q's that y'all had & give you a few hints on capacitors & controlling this beast.

The most asked Q was how to read the value as stated on the cap. Sometimes you get lucky & the cap will have the value in microfarads printed on it, e.g., .47, but most times it will be stamped as a three digit number such as 474, whereby you use the first two digits & the third is the multiplier (number of zeros to add)... in this case 470000 & after the demimal point is moved to the left 6 places it becomes .470000 microfarads & after dropping the unneeded zeros it's just plain .47uf ("u" representative of the greek letter mu which means micro, and "f" for farads... capacitor unit of

measure.) In case you didn't guess where moving the decimal 6 places came from, micro means one millionth.

Second most asked Q was how to determine the polarity. There is no polarity, so they can be inserted in either direction.

I know I've said I won't get into the technical aspect of things on these pages, but knowing how connecting multiple caps effect their total value can be of use in fine tuning this width circuit, so I will briefly explain how to combine them for new values. Unlike resistors, which add total values together when two are connected in series (end to end chain-like), total capacitance will be the product of the two capacitances divided by their sum. Simplified for this use, suffice it to say that connecting 2 capacitors in series will result in a value less than the smallest value of the 2, so you would be making a smaller microfarad cap by combining the two. How can this help you.... let's say you have 3 caps, a .47uf, a .33uf & a .1uf and you find that the .1uf makes the pic way too wide and subbing in the .33uf just won't make it quite to the edge of the screen, so you need some value in-between. By connecting the .47uf in series with the .33uf cap your end result will be somewhere less than the smallest value which is .33uf, so roughly speaking a .2uf cap. (Well... actual value would be .19 & change :-)

Moving on to connecting caps in parallel & we get a total capacitance equaling the sum of all the individuals, i.e., .47uf joined to a .33uf side-by-side will be .80uf. If you have a width circuit that needs a value of .56uf for optimum pic, combining the .47uf & .1uf in parallel will give you a .57uf well within the 10% margin even if this was a critical cap.

Enough of the half-techie stuff..... hopefully that is clear enough to help you fine tune, but it doesn't hurt to experiment with this circuit, anyway, providing you don't try to wander too far from the original value. Perhaps changing a .1uf with a 1uf & turning the thing into a popcorn machine :-)

Some monitors are width selectable, so be sure to look over the chassis before you leap in. Quite a few of the Asian chassis' will have three values of caps side-by-side with one end of each going to post sticking up from the bd, while across from these three posts will be a wire coming from the bd with a connector on it that slips over the end of one of the posts. Whichever post the wire is on, that cap is in circuit while the other 2 are dormant (I guess this word is "passive" in today's jargon :-), taking up real estate until, or if, needed in the future. I suppose if you were so inclined, you could mount a piece of perf bd on any chassis frame, mount 3 values of caps & extend 2 wires up from the original cap position to make your own width selector. Just food for thought :-)

Trial & error may be the best way for the hobbyist to tune in the width circuit... if need be. For example, if you have a K7000 chassis that has a pic off the screen & cannot be reduced with the width coil and a .15uf cap is installed in C38 position, simply pull the chassis & remove this cap & install a .33uf cap & slip the chassis back in... secure at least 1 screw... and fire it up & take a look at your results. If it's okay, power down & finish up your installation. Needs fine tuning.... pull it out & adjust to your guess for a retry. Since this is not going to be something you do everyday... maybe only once in a lifetime... I think this would be the easiest way.

Here's the common ones I promised:

- **Common Width Cap Positions**
- Wells-Gardner K4600 Series - **C615**
- Wells-Gardner K4900 Series - **C365**
- Wells-Gardner K7000 Series - **C38**
- Electrohome G07 - **C515**

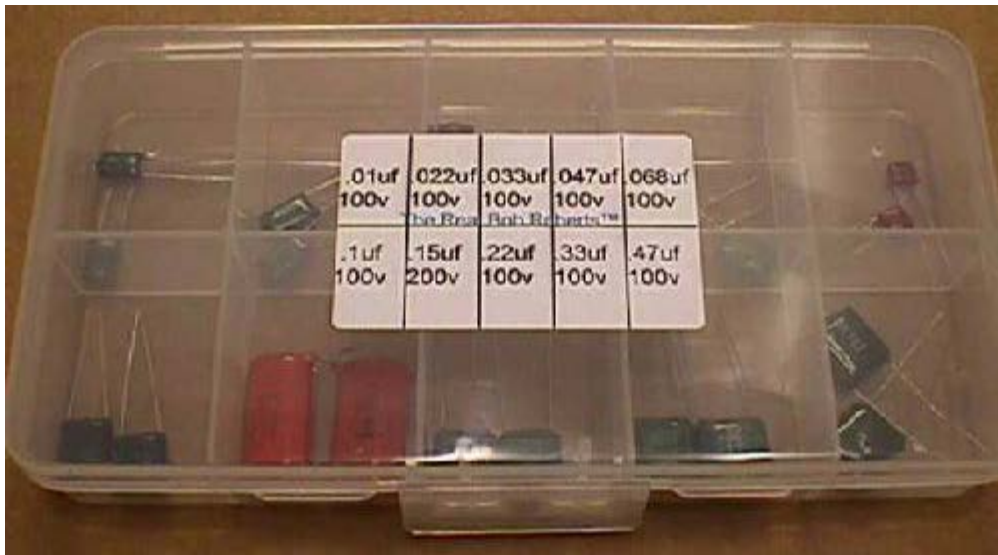
The contents of the new width cap kit is below & I'll post the kit back to the [Cap Kit Page](#).

- **Width Cap Kit**
- 104 (.1uf630v)
- 154 (.15uf630v)
- 184 (.18uf630v)
- 274 (.27uf400v)
- 334 (.33uf630v)
- 474 (.47uf250v)

- 474 (.47uf250v HD)
- 474 (.47uf630v)

Hopefully, this will help solve some of the width problems that quite a few of you have been tinkering with.

Happy Gaming....



The Mylar Capacitor Kit Contains
Two Each Of The Following Values

0.01uf 100v	.022uf 100v	.033uf 100v	.047uf 100v	.068uf 100v
.1uf 100v	.15uf 200v	.22uf 100v	.33uf 100v	.47uf 100v

Bulk Electrolytic Cap Kit

I've had a lot of request for a bulk electrolytic cap kit lately, so I put together this one using the most common values used in the monitors.

5 Each Of These Values - 150 Total					
1uf50v	4.7uf50v	22uf25v	47uf50v	100uf160v	470uf25v
1uf250v	4.7uf250v	22uf50v	47uf250v	220uf25v	470uf50v
2.2uf50v	10uf50v	22uf250v	100uf16v	220uf50v	1000uf16v
3.3uf50v	10uf160v	33uf25v	100uf25v	330uf25v	1000uf50v
3.3uf160v	10uf250v	47uf25v	100uf50v	330uf50v	2200uf35v

Neotec Monitors

I never had the pleasure, or displeasure depending on how you look at it, of working with these monitors & didn't have any info on them. It seems I wasn't alone in that aspect as I kept getting emails from many saying they could not find anything on these. With help from all of you I was able to get a kit together in 2002 & it's been a process of continually getting bits & pieces of info ever since. I added 2 of the flybacks to stock when I didn't even know what they were... just going on what y'all had requested. I've gleaned a lot more info from the net & not everything is 100%, but I figured I'd put the general info up here for you to use at your own risk before I forget all of it.

There are many discrepancies among your supplied material, manuals & schematics... as slim as they are... layouts & etc. You've supplied 2 different layouts & 2 different schematics stamped with NT-2700, so there may be two versions of this one, or it may be mis-labeled material. There are confirmed differences between parts lists & actual components, as well.

I've come up with a combined cap kit that will serve most of the models & it covers the main chassis & the neck board. Some versions will not have a cap in the listed position & as with any chassis, if there is nothing there, do not put one there. Usually caps in a pincushion circuit are not a problem, but it has been said that C19 has been a problem on the Neotec pincushion bd, so I will be making a separate Neotec pincushion cap kit for those who want it. I'll try to make a table here that will cover most of the info I've been able to come up with.... such as it is.

Note: Online info shows each of the three flybacks used for every model listed & even cross ref sites point differently for each model, so I'm going to list what I believe is the correct flyback/model in each category. If you have something different with stickers on the chassis & the flyback to verify it please let me know & I'll adjust it.

"C" CGA Std Res Models Use Combo Cap Kit & MRCFT-216 Flyback
 NT-1915 NT-2500 NT-2515 NT-3300

"E" EGA Med Res Models Use Combo Cap Kit & MRCFT-249 Flyback
 NT-2501 NT-3301

"V" VGA Res Models Use Combo Cap Kit & MRCFT-252 Flyback
 NT-1931 NT-2502 NT-2602 NT-3302

Labeled Models Also Covered By The Combo Cap Kit
 NT-25E NT-27E NT-31E NT-33E NT-31V 33C

The combo cap kit will be on the [Cap Kit Page](#) at the same \$9 pricing & the pincushion cap kit will also be listed there for \$5 and will include the following caps:

1uf50v C2
2.2uf50v C4 C7 C8 C9 C10
3.3uf50v C5
6.8uf50v C19 HFBP
10uf50v C6 C13 C16
22uf50v C12
100uf50v C3 C15
220uf50v C1

Thanks to Ken Layton I now know why the NT-2700 series has been confusing to some of you. Probably 50% of you order the Combo Cap Kit & say it matches perfectly to your 2700 series chassis while the other 50% order the NT-2700 - NT-3506 kit claiming it matches their chassis perfectly!

Turns out the answer is simple & something found with many Asian chassis' as I had suggested at the beginning of this article. More than one version of the same model number! Ken has explained how to ID which one you have & I will post it here to help you get the correct kit for your chassis.

The typical NT-2700 series that carries forward with the same Combo Cap Kit & Pincushion Kit as it's predecessors, is described as the Li-Chin chassis. Ken says an easy way to ID it is that C118 & C119 will be populated with 1000uf35v caps. The PCBs will be silked with "Li-Chin" to further aid in ID.

Version 2 uses the NT-2700 thru NT-3506 cap kit & will be silked with "Full Family". C118 & C119 will be populated with 100uf160v caps.

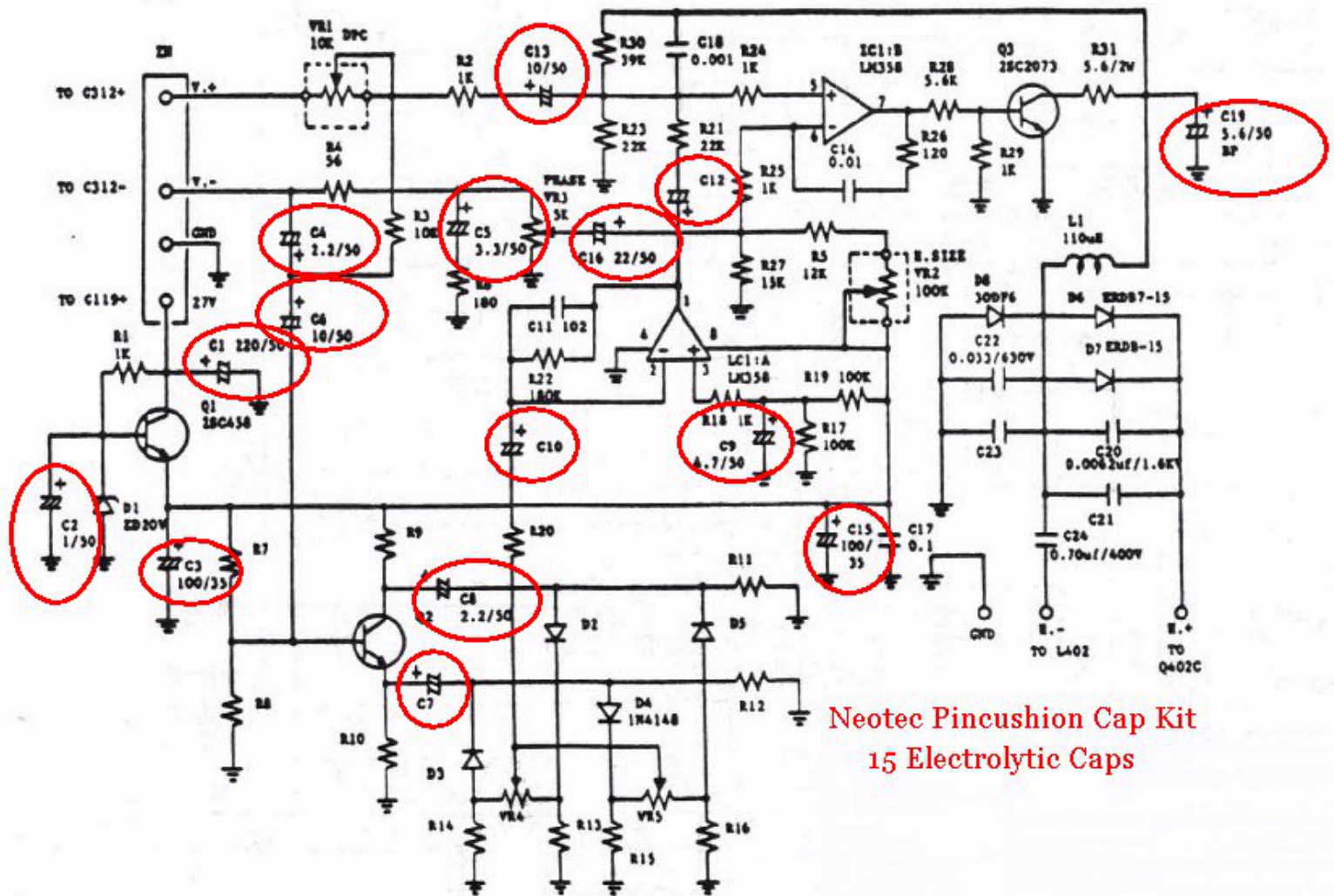
Ken also notes that your chassis may be plain with nothing silked on it whereby you must rely on the cap values in C118 & C119 for proper ID.

NT-2700 NT-2701 NT-2702 NT-3500 NT-3501 NT-3506

I think it's safe to say that if your last two digits in your model number are "00" then you have a CGA monitor... if they are "01" it's an EGA monitor... and "02 & up" would be a VGA monitor.... at least that seems to be the precedence.

The flybacks are on the [Parts Page](#) at \$30 each, as well.

If I get any more info on these monitors I'll post it here where I cannot forget it :-()



Neotec Pincushion Cap Kit
15 Electrolytic Caps

20EZ Nintendo Video Inversion Parts Kit

100Kohm 1/4W	R201/R202/R203
100Kohm 1/4W	R210/R211/R212
820 ohm 1/4W	R213/R214/R215
560 ohm 1/4W	R217/R218/R219
2SC1815	TR201/TR202/TR203
220µf 25v	C202
1N4007	D210

The Sanyo 20EZ chassis left out components in the video circuits of Nintendo monitors for inverting the negative video to positive video, used by most game manufacturers. The early Nintendo game boards outputted this negative video, so the circuits were not needed. In later games they mounted a separate inversion board on the flyback cage to invert this negative video to a positive video for their newer games, but left a non-inverted output header for use with the older game boards. If you have the inversion board on your Sanyo monitor it can be used with the majority of other game boards out there that have positive video. If your monitor does not have the inversion board... or if it has been pilfered... you can add the missing components right on the chassis as silked. Doing this will make the single video output positive, disabling it's use with early negative video Nintendo boards unless you add the separate inversion board, but making it compatible with the majority of games boards available today.

There have been many values assigned for these components since the early 80s, but this kit contains the part values most often referred to in industry magazines, tech mags & in internet articles. Even though this is a "parts" kit only, I will put the basic instructions, such as they are, below. Although this is not a compilation of mine, I can say that I converted hundreds of these monitors over throughout the 80s for use with new game boards & found that most ops were overjoyed with the results.

Remove the wire jumpers that take the place of TR201, TR202 & TR203.

Remove R213, R214 & R215.

Install kit components in positions as outlined at the top of this page.

Wells-Gardner K8000 Chassis

This was one of those chassis' with little to no documentation except for 3 different sets of schematics that didn't agree with other. Several people have asked about a kit for this chassis & have supplied me with cap lists. These lists all had discrepancies among them, as well. A recent list supplied by Gene Zouzalik was closest to two of the schematics & one of the previously supplied list. Presumably, the variations in values come from previous tech replacements during servicing. I cross referenced all lists & came up with a rough cap kit of all those verifiable by the schematics. There are 4 inconsequential caps listed differently, or omitted from lists, that are not verifiable via any schematic, but there are 3 caps on the schematics not listed on anyones supplied list, making for a kit of 22 total electrolytics encompassing all common failures among monitors. Because of this, there may be caps/positions in the kit that are not physically on your particular chassis. As with all kits, if you find a position, but it has never had a cap in that position previously, do not install one... your chassis does not require it. In the same respect, if you find an electrolytic that does not have a replacement in the kit, chances are that it is an inconsequential cap that should outlive us all with no outside interference from Mother Nature or an experimenter.

Additional field note: C513 on neck bd not used on some versions.

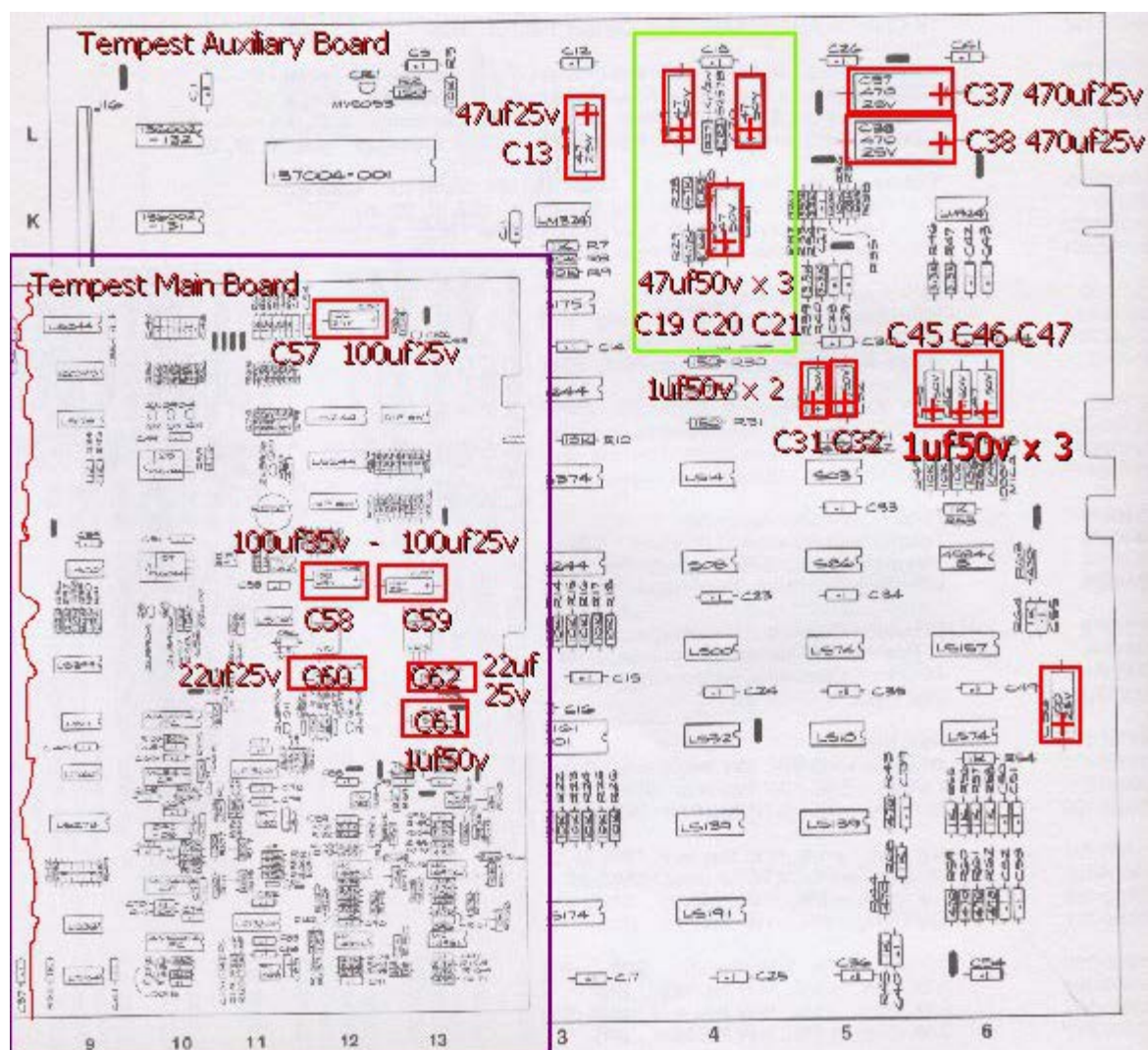
U2000-U5000-K74/7500 Chassis'

With only subtle changes in the progression of the U2000 chassis to the K7500 many of you mis-identify the chassis that you have & end up a few caps short. I've put together a kit to cover all versions of this chassis using 105° capacitors. It will cover any caps needed with a few leftover. The layout sheet with positions for each chassis will guide you with installation. As always, if your chassis does not have a capacitor in a particular position, do not install one. If you find a position with a cap other than an electrolytic, do not change it.

This WG combo kit should make your recap of any one of these chassis' snafuless ;-)

**Asteroids Deluxe Uses Same Caps As Asteroids
Plus Two 1uf50v & Two 10uf25v Caps
Position Numbers Are Different Though**

1uf50va	C22/C49/C50/C74/C83/C85/C103
10uf25va	C121/C122
22uf25va	C104
100uf25va	C17
470uf25va	C72/C73



Omega Race PCB Cap Kit

All Axials Mother Board

4	10uf35v	C107/C108/C109/C112
1	22uf35v	C110
1	220uf25v	C116
1	470uf35v	C106
1	1000uf35v	C113

Daughter Board

2	10uf35v	C201/C207
3	470uf25v	C202/C203/C209
2	1000uf35v	C205/C210

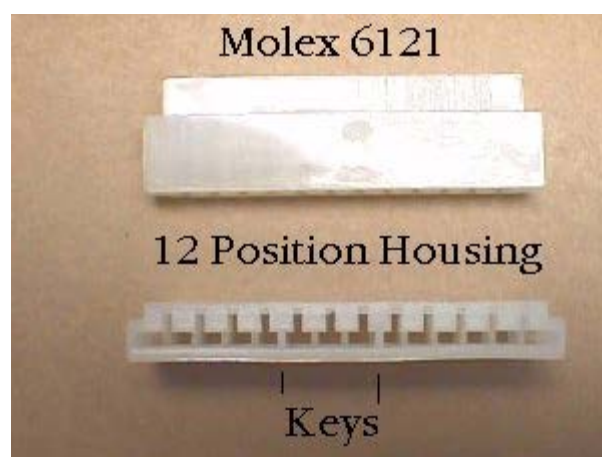
The actual voltage rating value may be higher than stated & only serves for a higher safety margin, & is a perfectly acceptable replacement. Do not use a lower than stated voltage rating.

Polarity must be followed... + to + silked on PCB... but the best course of action would be to replace them one at a time, carefully observing how the markings are on the original cap, as sometimes a pc board will be incorrectly silk-screened.

Obsolete Connectors

A few weeks ago a local tech stopped in looking for a connector for an old Seeburg juke. He was looking for a single sided Molex .156 edge connector, so I went digging through some of my old connector bins & came up with a few leftovers, one of which he was able to use. They've been sitting here on my desk... in my way... ever since, so I just snapped some pics & will post them here in case they are of use to anyone else. These are just the housings & you'd need to get the .156 pins to use with them.





[Site Index](#) - [Big Bear's Bulletin Board](#) - [Parts Page](#)



24 Position Header - \$1.00



As most of you know, I'm always looking for solid 24 position .156 headers to use in making the power supply conversions to switchers. Every once in awhile I'll be assured that they are solid connectors & end up with the break-away type as above. While these are no good for my purposes... free hanging connectors...

they are perfectly good to use as designed, mounted on a pcb for a stable connection. They can be used to replace headers with scorched pins in linear power supplies, on interface bds, Williams bd sets or any bds that use .156 headers for interconnects. They'll easily snap off at desired number of positions, e.g., one connector can be used to replace a 9 position & 15 position header, a common usage, or any number of combinations possible from a 24 position header.

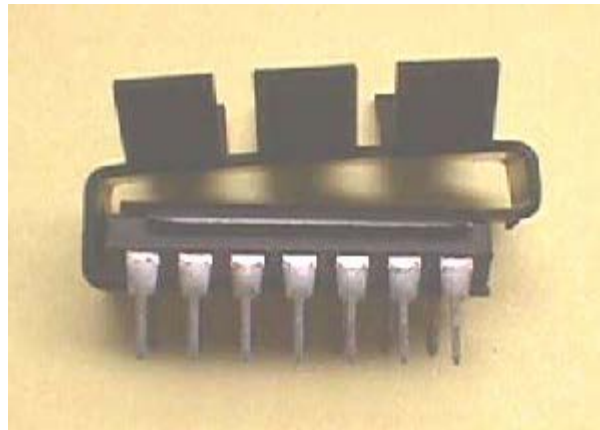
Happy Gaming.....

Heat Sink Note

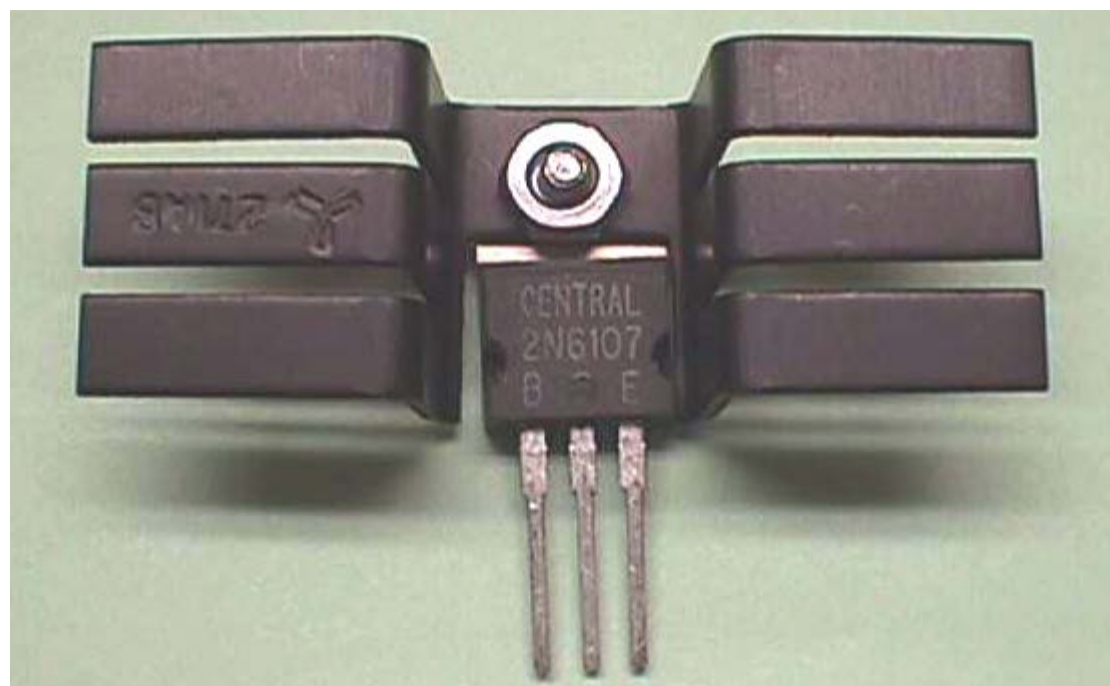
By Bob Roberts

These heat sinks are a very unique & easy way to dissipate the heat generated by 14 to 16 pin ICs such as those on the Pac-Man boards at positions 2A through 2D. If your ICs are good & only missing the heat sinks you'll need to glue these on as the OEM chips were sitting flat against the PCB when soldered in. You can glue the spring clip to the top of the IC or you can cut off the spring clip portion & glue only the fin portion of the heat sink to the IC. I use to use GC's Radio Service Cement, but I've been told that was discontinued. I'm sure there must be some equivalent on the market today... or perhaps something better for this purpose. Some of you have reported a few odd ways that have worked, such as TC who says that fingernail polish works great :-)

If you are replacing the IC that requires a heat sink then these are made to order easy for you & require no glue at all. They simply clip on the chip and in doing so, use both the top & bottom of the chip as surface contact points, funneling the heat to the fins for dissipation. You can clip them on prior to installing the IC or just be sure to leave the IC up off from the PCB enough to clip them on after soldering... although clipping them on prior to soldering may be beneficial in keeping the chip cool during the installation period!



These black anodized aluminum heat sinks really do a great job of keeping the chips cool & are much better than the OEM in MHO. They sell for a buck a piece at most electronic parts stores, but I was able to find a batch of them at half that when my supply of them ran out & y'all kept asking for them. Hopefully, I've got enough to last a good while now, so they can continue to be on the Dollar Store Page at two for a dollar.







I'm not crazy about these machine
pin sockets, but many of you have asked
me to keep some in stock for you.
These are the wide sockets for



2101 - 5101 - 93422 and others











Used 36/72 Split Pin Connector





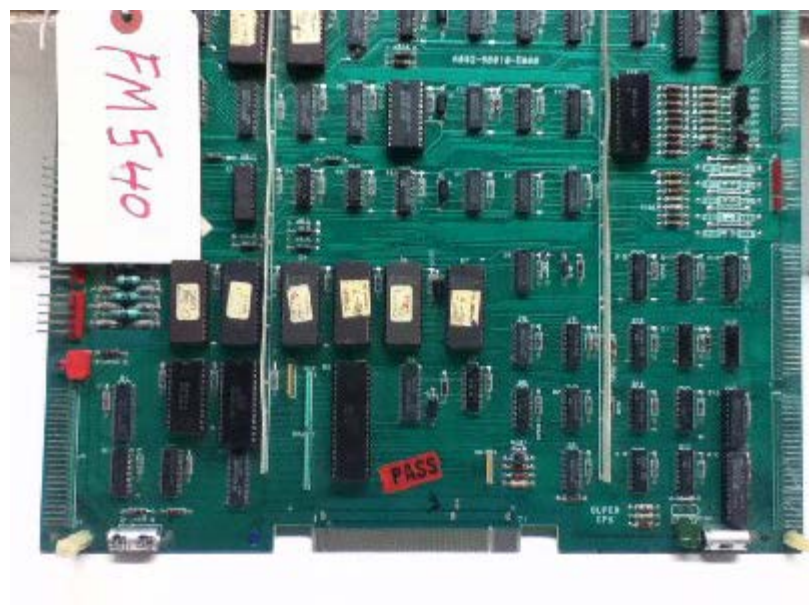


















MK III P12 Cable



40 Pin IC Sockets - Shipped to us in this bag with many bent pins.
We straightened many & used them, but it is too time consuming



























































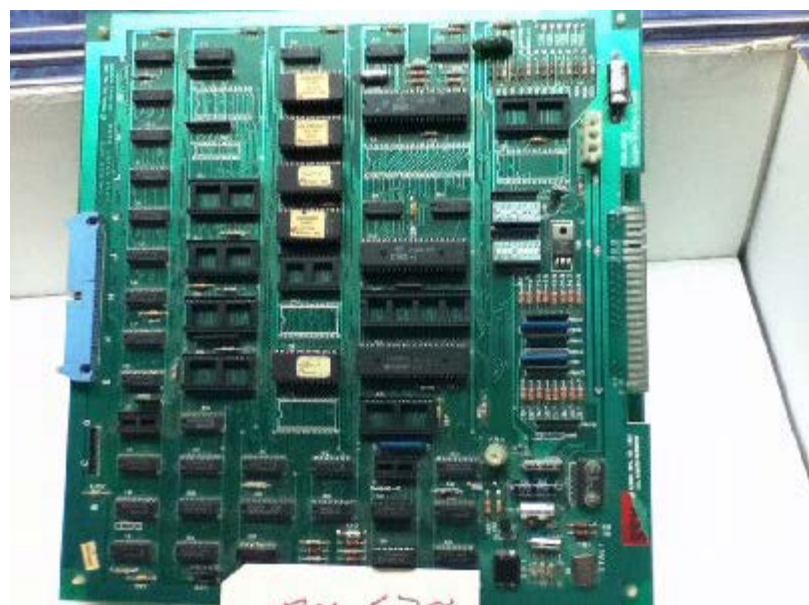




















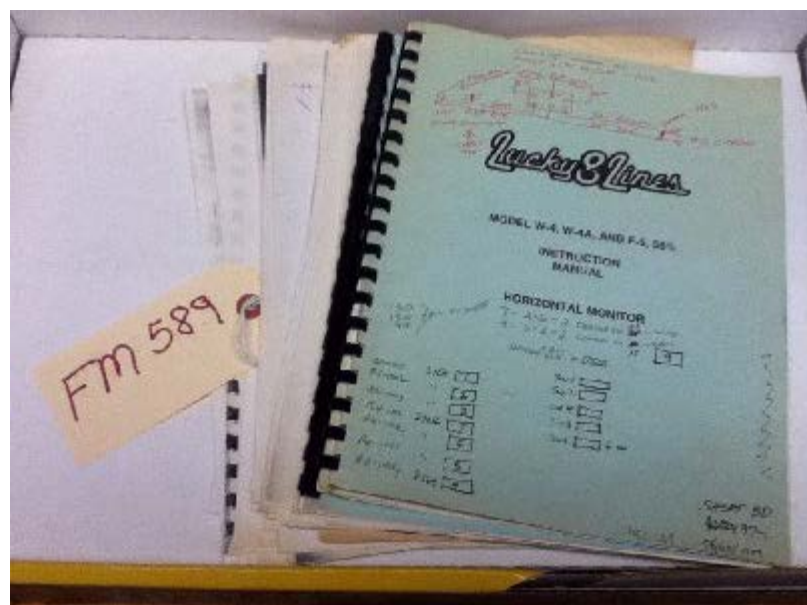


















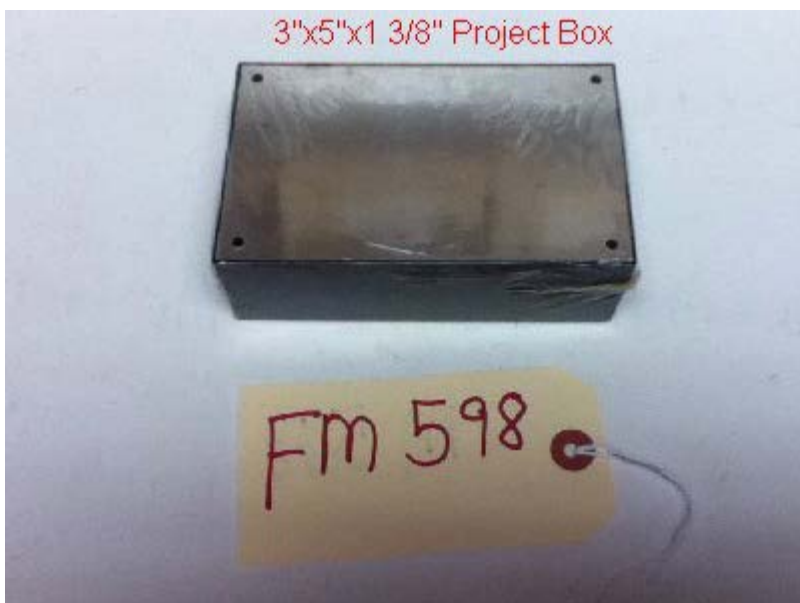






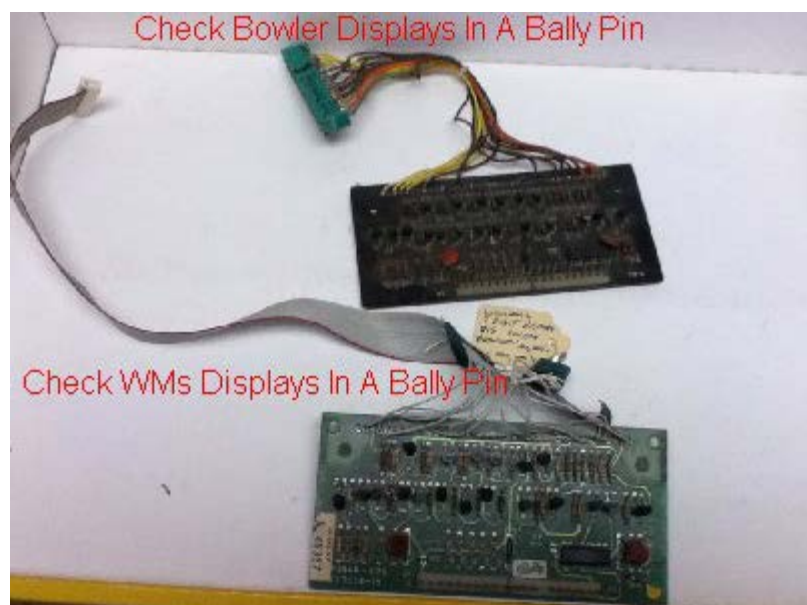












Need A Nintendo Inverter..
Toss The Harness & You Have One!

















Eprom Programmer



Old school programmer. Lots of steps to this & the manual has to be read carefully. It took me several times of reading over the manual to try and program a 2532 which I found to be a little complicated, but that just might be from the strokes :-(I actually spent about an hour playing with it before finally getting a Pac chip programmed. A novelty item, if nothing else.

It has modules for programming:

- 2516
- 2532
- 2564
- 2716
- 2732
- 2732A
- 2764 x 2
- 2764A

CRT Tester/Rejuvenator

































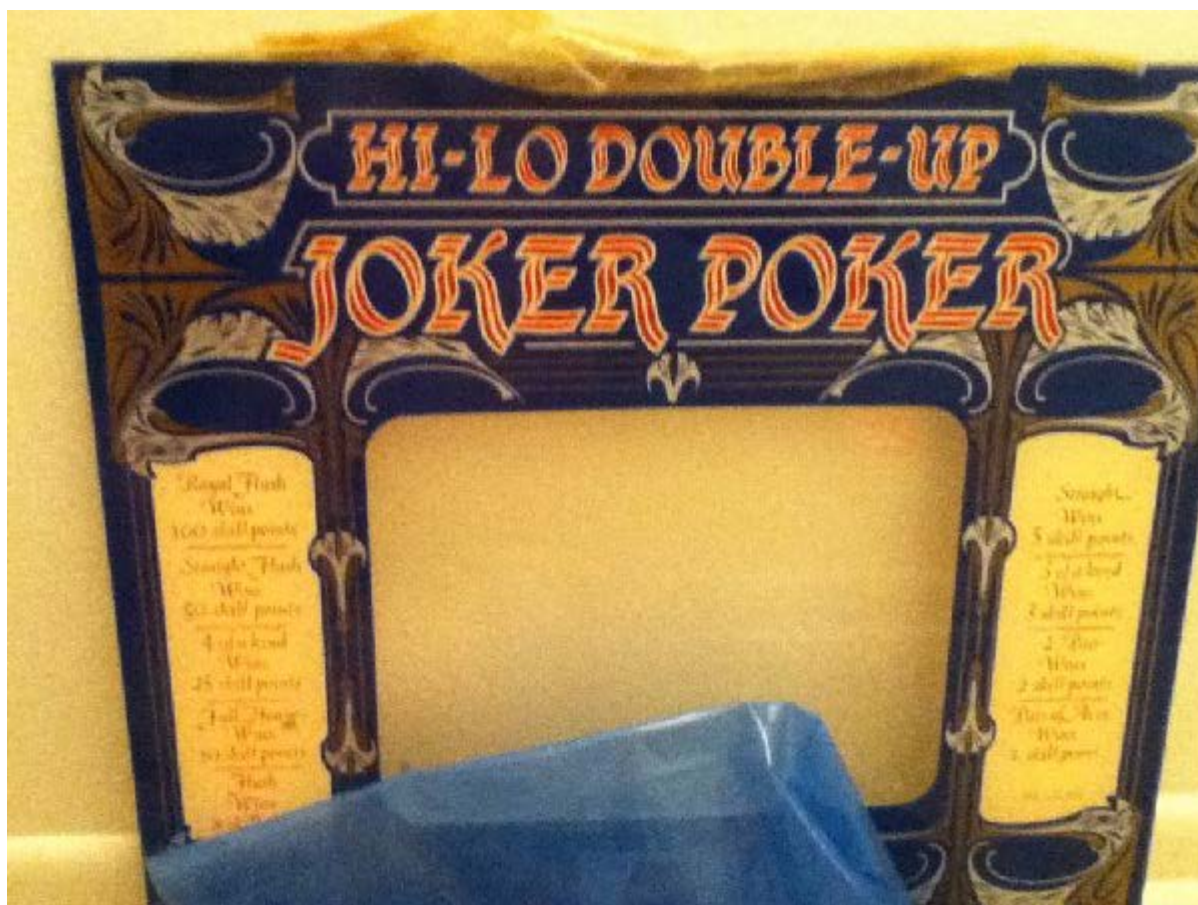




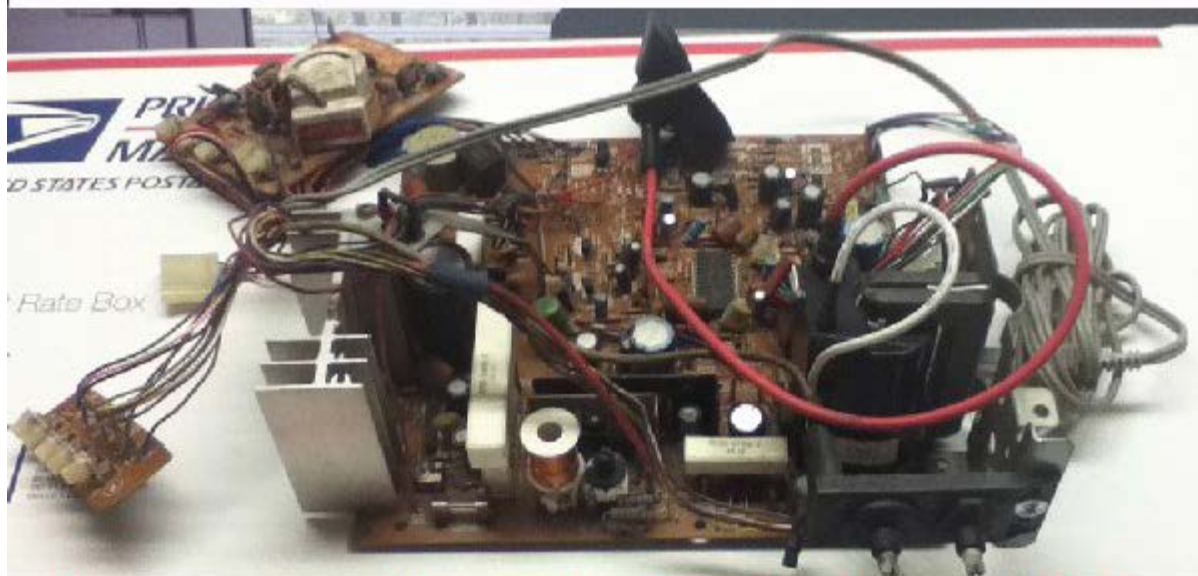








This is the chassis I bought to demonstrate changing the flyback on a Sanyo 20EZ. That's a new unused flyback mounted.



Chassis was supposedly in good working when the original flyback blew, so a cap kit should bring it back to life in good shape.
No inverter bd or audio bd.

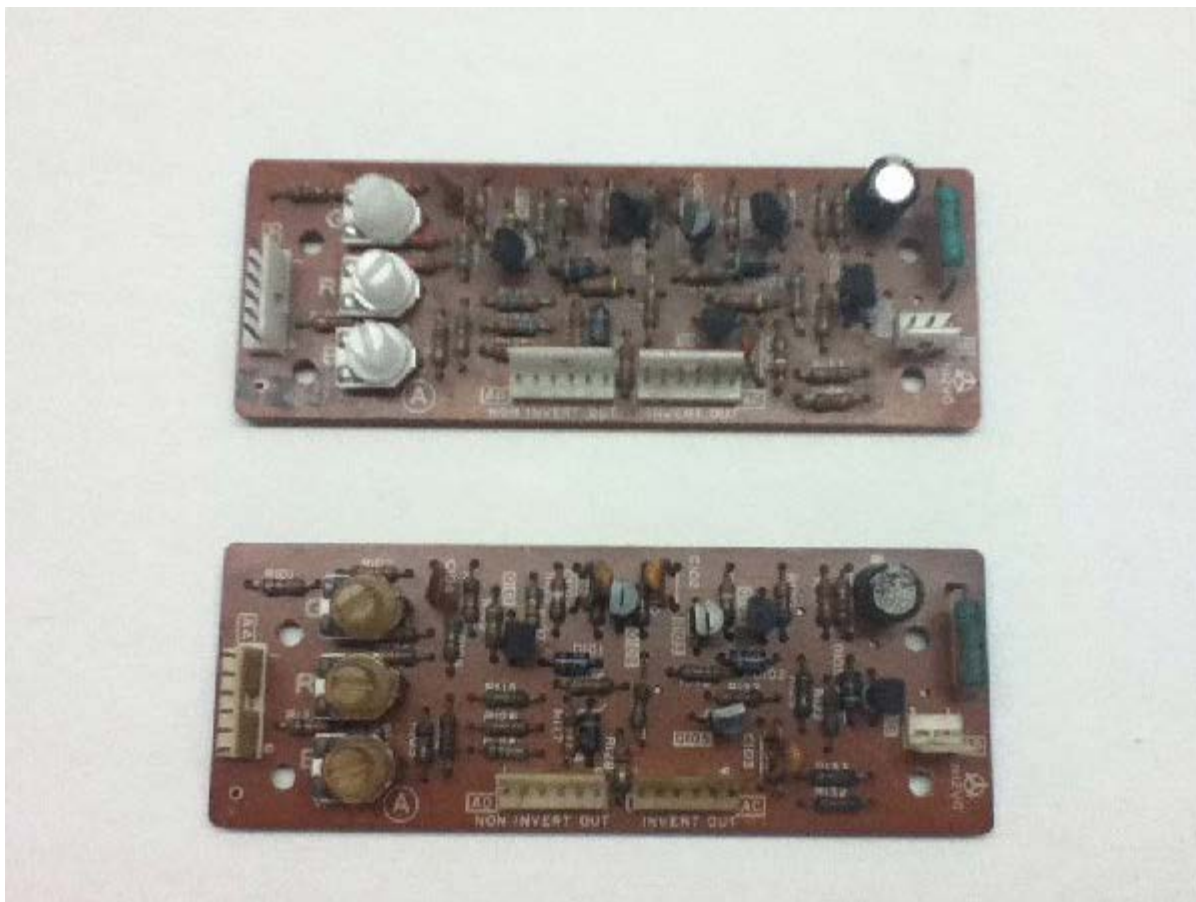


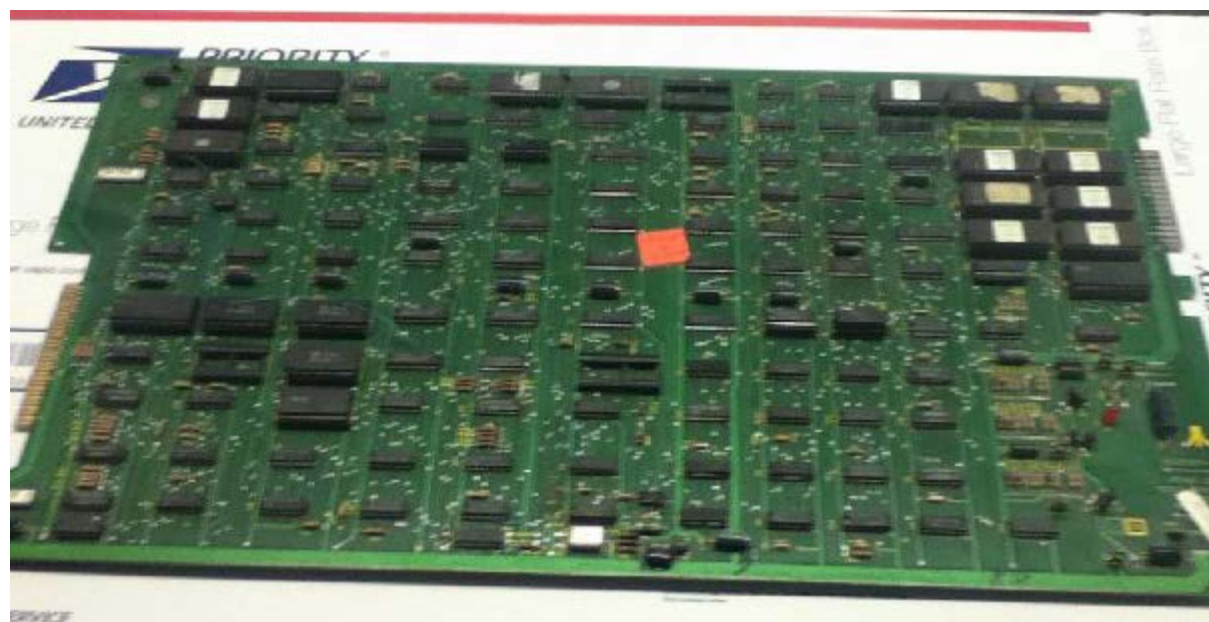


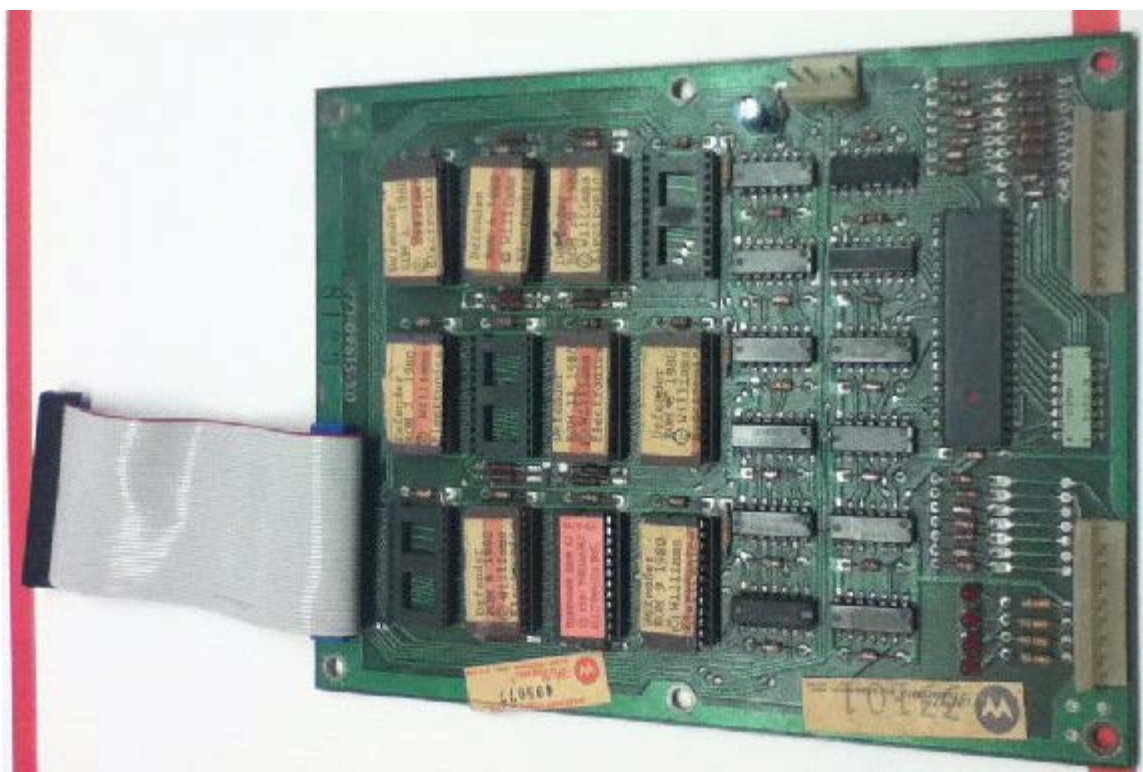




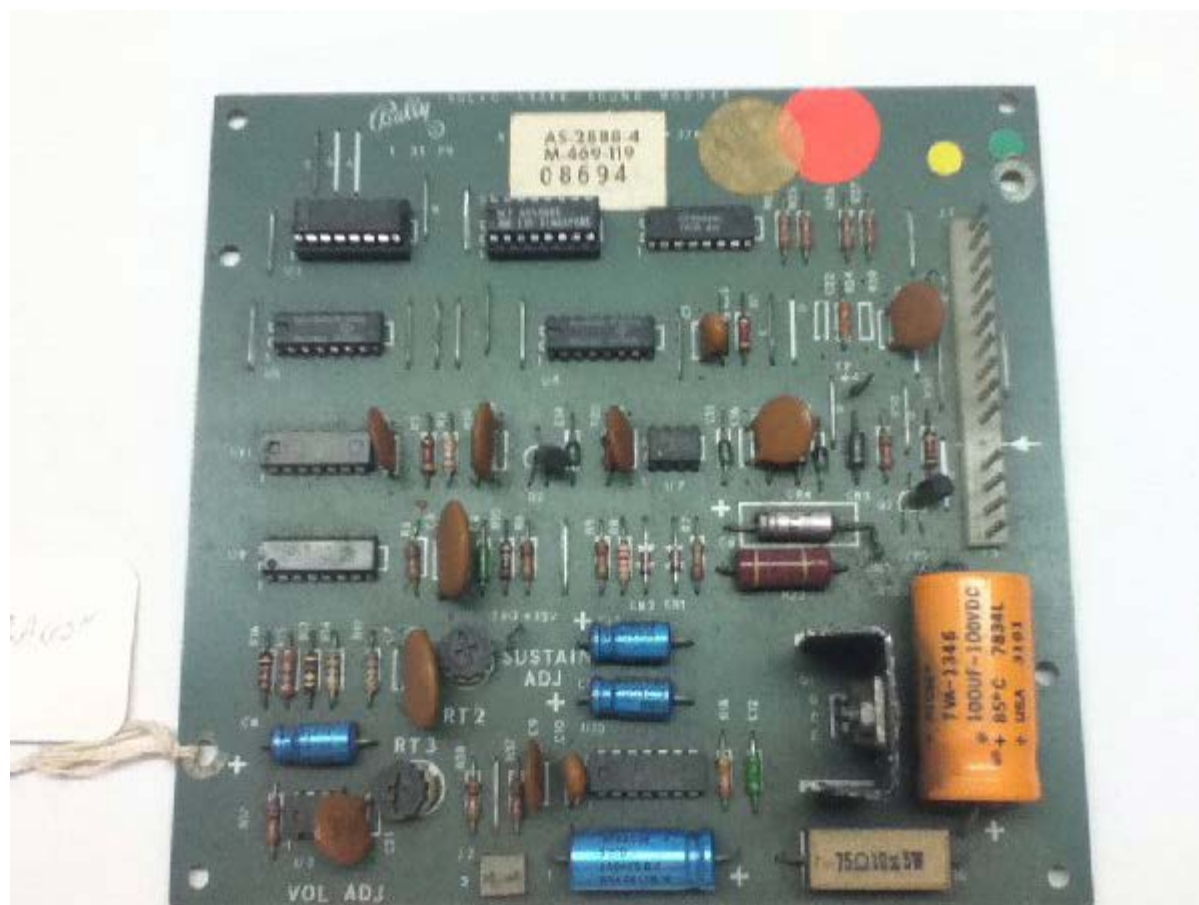


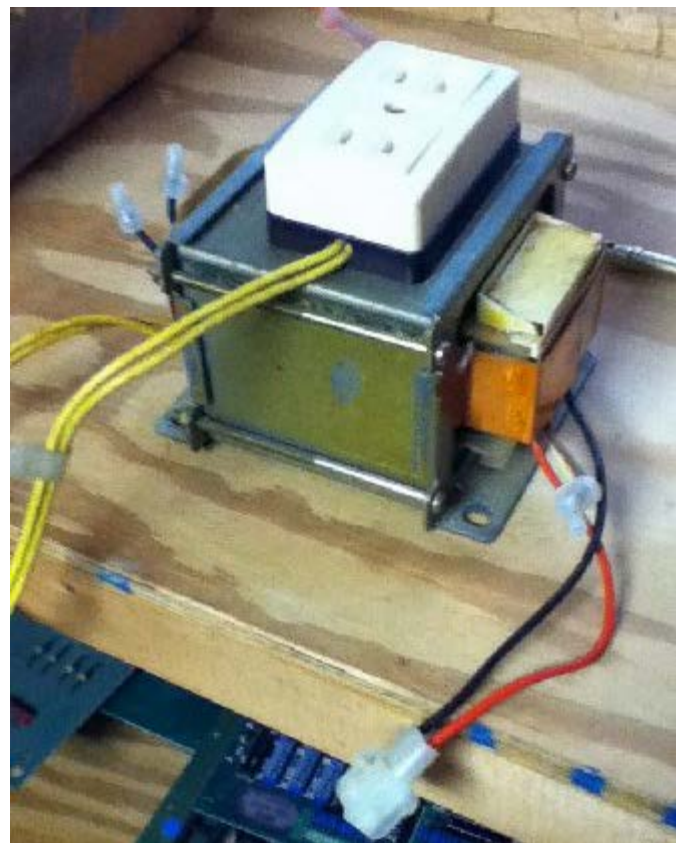






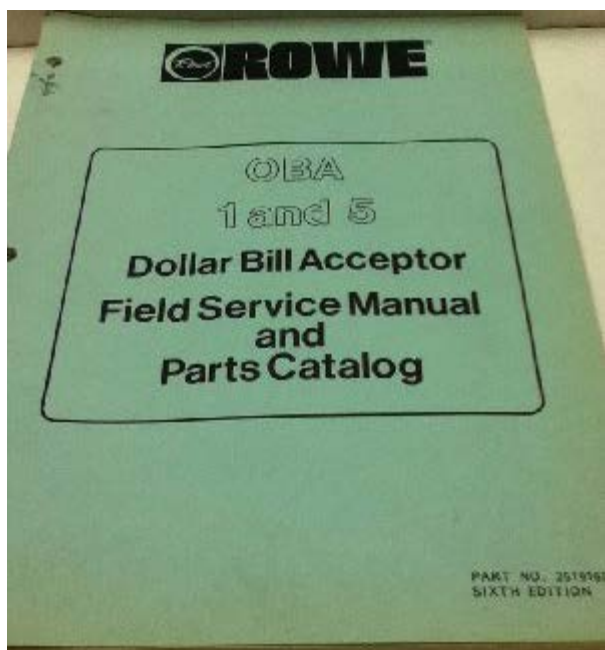


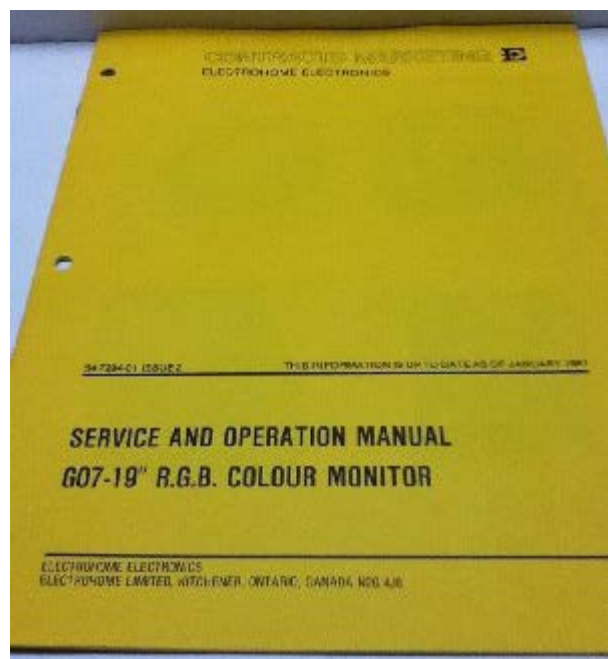


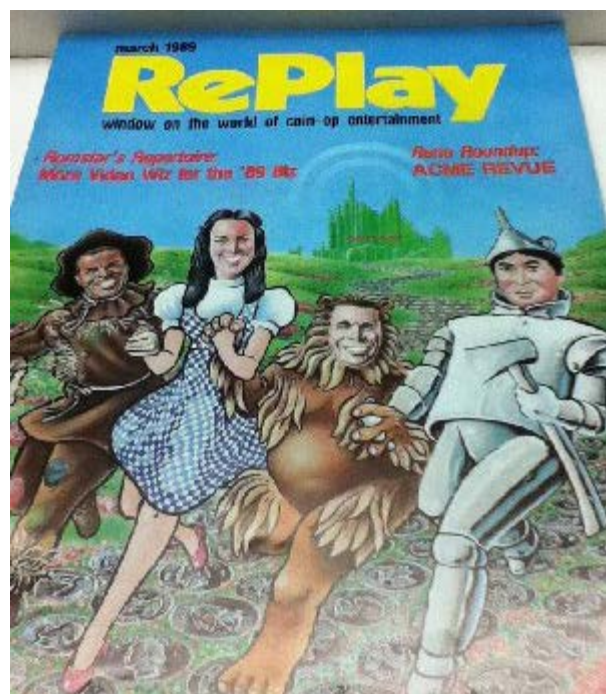








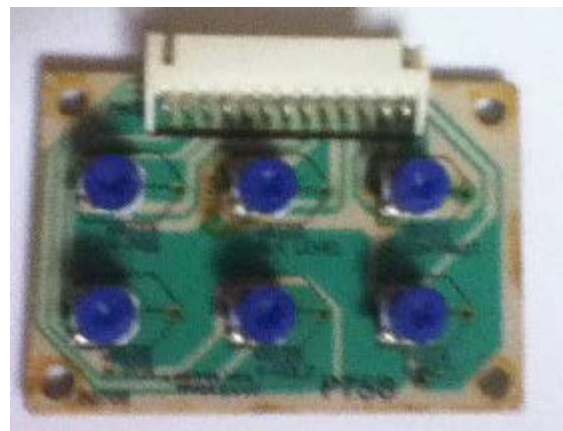








Add an AC outlet in your project for your soldering iron or a lamp to aid while working in your dark cabinet.







This is a bench jig for a pair of hand crimpers such as the HT-1921s. Our harness maker wanted it but could never figure out how to use it properly & got discouraged with it, so it's now up for sale.









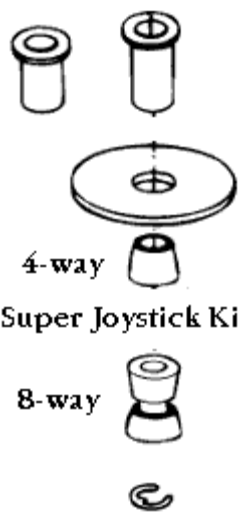
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fm301.jpg %d x %d pixels











AC power on indicator. Plugs directly into outlet
or can be mounted remotely. Great on jigs!



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pts10g.jpg %d×%d pixels



pts20b.jpg %d×%d pixels







fm346.jpg %d×%d pixels



fm347.jpg %d×%d pixels

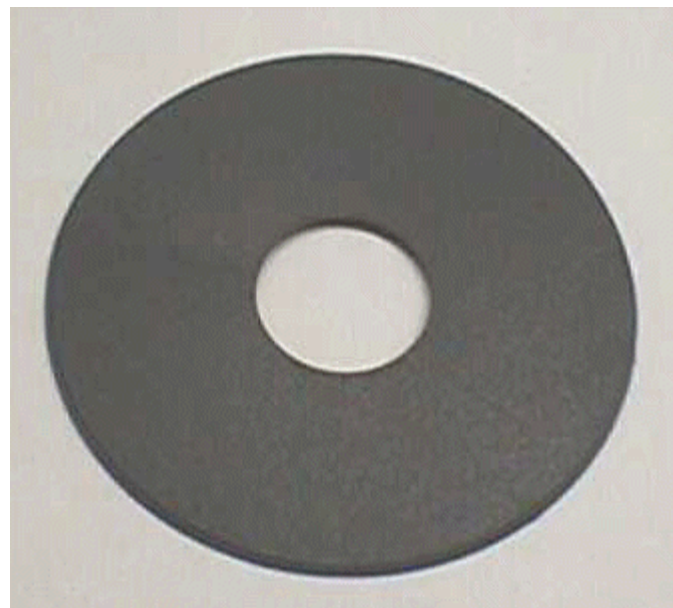


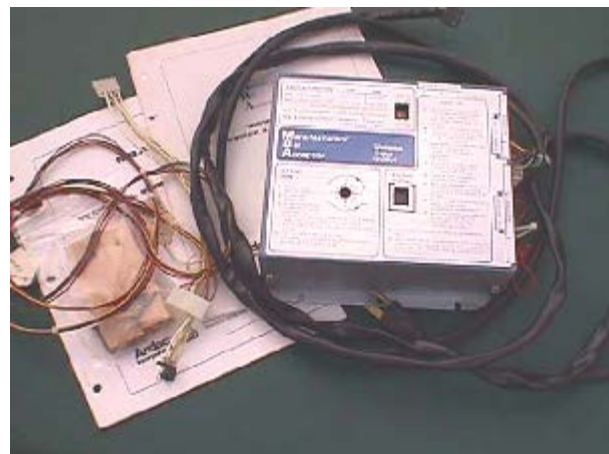
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**Multi
Drop
Bus**

**Bench Test
Power Supply**

PN 48x800-33

(216) 946-3000

CBU ??

Mako??



54 USED SAMS PHOTOFACTS

0879 0909 0981 0988 1015 1030 1116 1119 1127

1166 1177 1201 1217 1231 1239 1253 1254 1272

1279 1306 1322 1347 1366 1384 1395 1398 1406

1427 1442 1445 1450 1459 1466 1482 1504 1521

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RePlay Mag Back Issues

Update 08/14/2014

RePlay Magazines
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Play Meter Mag Back Issues

Updated 08/14/14

Play Meter Magazines
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July 2007

Wire Pricing 2008

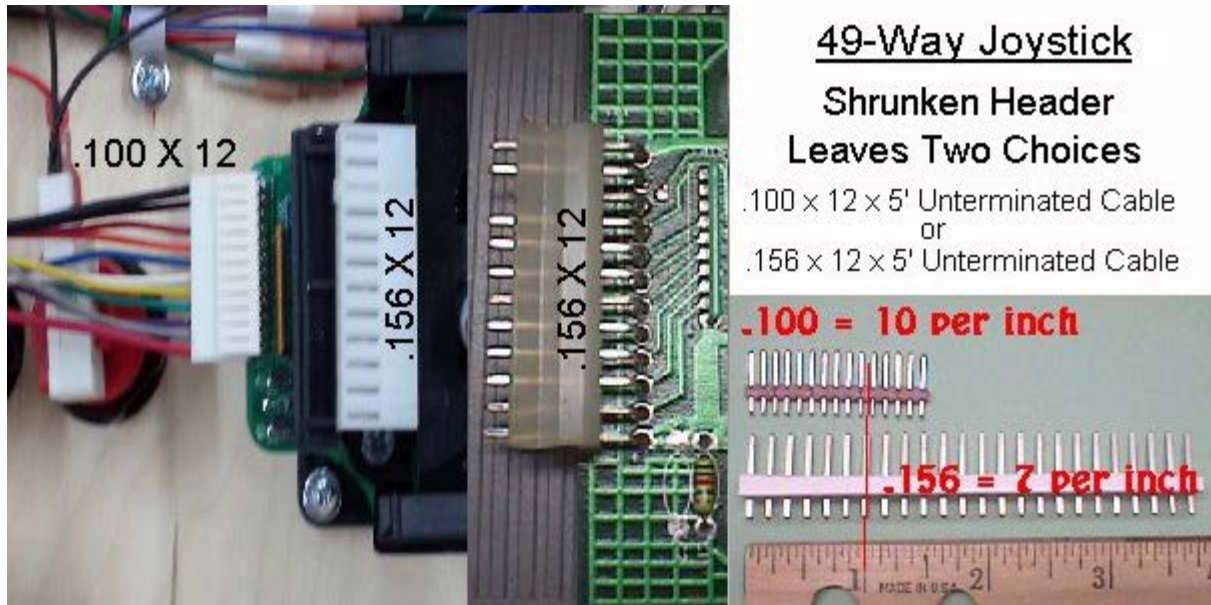
K... as many of you know already our harnesses have always been sold at a loss, but with several more wire increases due to the escalating copper prices... soon to overtake gold... we can no longer hold the price line. I'm embarrassed to say just how much we lose on wire & harnesses, but suffice it to say that the wire it takes to make a full JAMMA harness costs more than we charge for the completed harness at this time :-(We've held prices for you the past couple years after having to layoff one harness maker with the last increase we were forced to make after the 3rd wholesale price increase in a row, but now it is to the point of not being practical to even continue with harness making at all if we don't close the gap.

Since there are no other quality harnesses available for those who want them over the imports that are not worth the spaghetti they use to insulate them, and without labeling other than "Parts Side", we are going to attempt to keep making them with as little increases as possible. I know we could do away with labels, use cheaper imported connectors, pins, wire, reduce wire gauges to 22 & 24 and sparsely populate the connector with the bare minimum of wires to be competitive, but wait, those harnesses are already available at a huge number of places, so there would be no point!

I really hate to do this because I know there will be many hobbyist who cannot afford a quality harness or wire for their project, but I don't want to let this game cornerstone go by the wayside when I know it is an essential item on which to build.

The Real Bob Roberts™

49-Way Joystick Harness



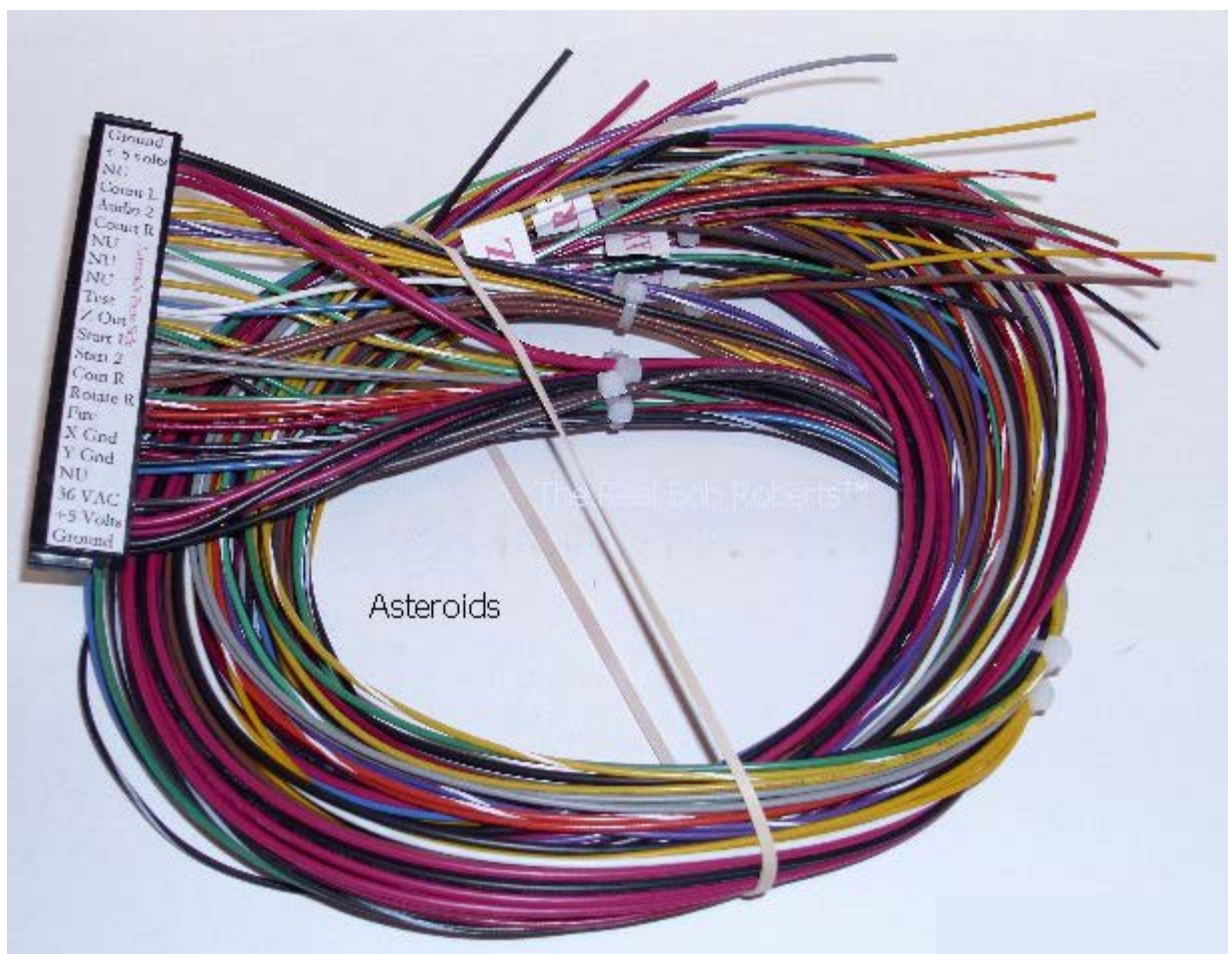
Sometime during the past 5 years Happ has changed out the header on the 49-way joysticks from a .156 x 12 header to a .100 x 12 header. We have always had the 5 foot unterminated replacement harnesses for the WMs & Happ original 49-way sticks & we'll now offer the harness in the new version. It'll be up to you to determine which one you need. I've placed help hints to guide you in the pic above.

Happy Gaming...

Super-Super Jamma Harness Kit

1 Jamma Harness
2 Molex .093 12 position connectors w pins & sockets
1 Bag of 50 .187 QDs fully insulated - CP & maybe spk
6 .250 QDs insulated - coin switches & maybe speaker
1 Amp 2 pos connector w pins & socs for speaker wires
1 Molex .156 IL 6 pos connector w pins monitor (vid)
1 Molex .156 IL 3 pos connector w pins monitor (sync)
1 10' black 22ga wire for switch ground loops
8 Spade connectors for power supply terminals
1 Amp 12 pos connector w pins & socs for coin door





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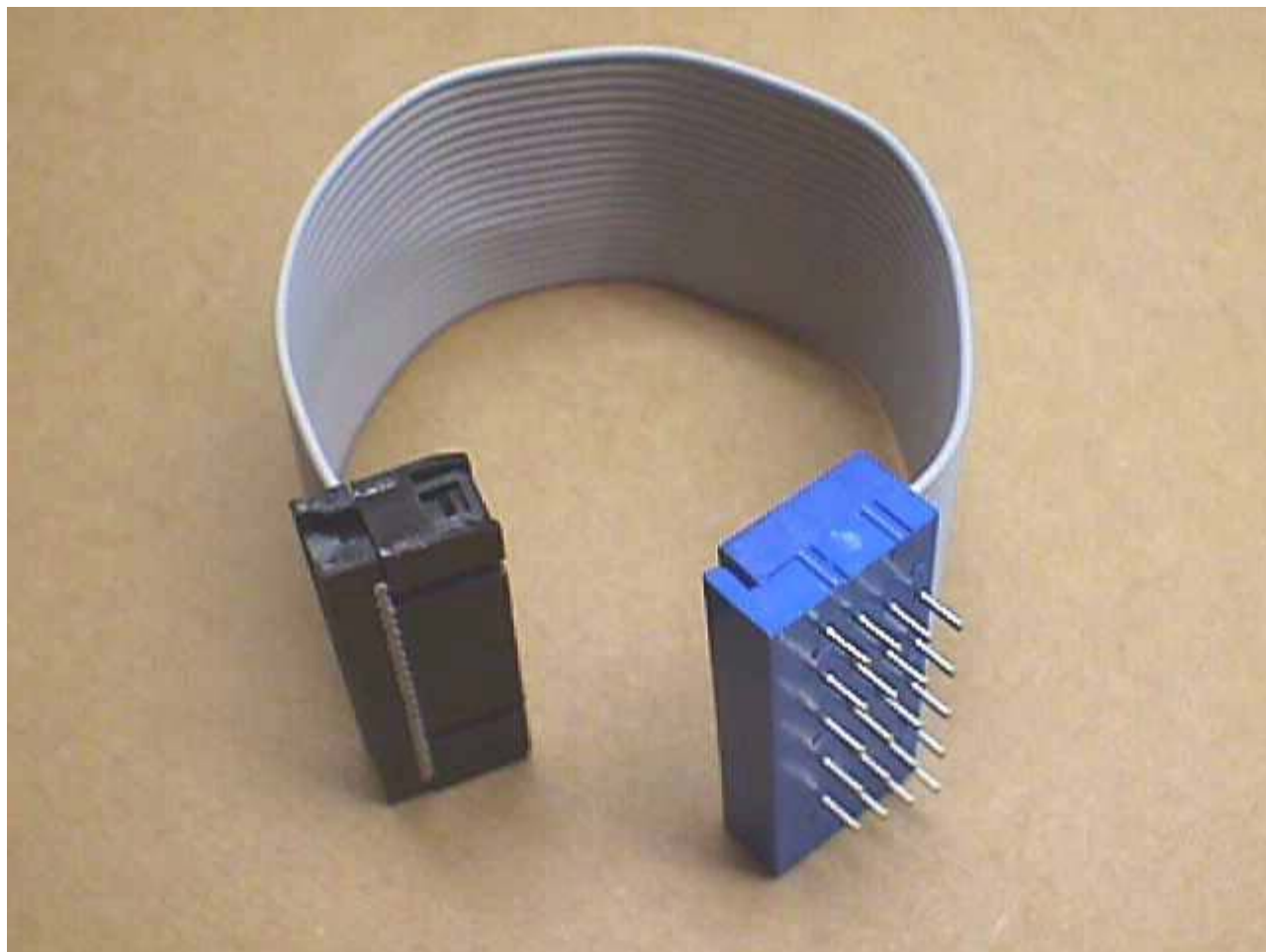


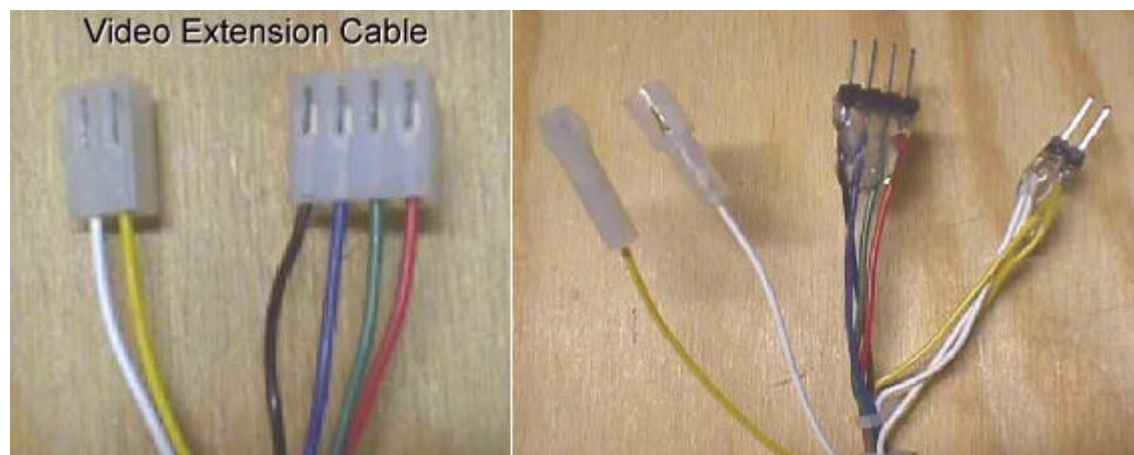
Atari A/R Power Supply Tester Adaptor











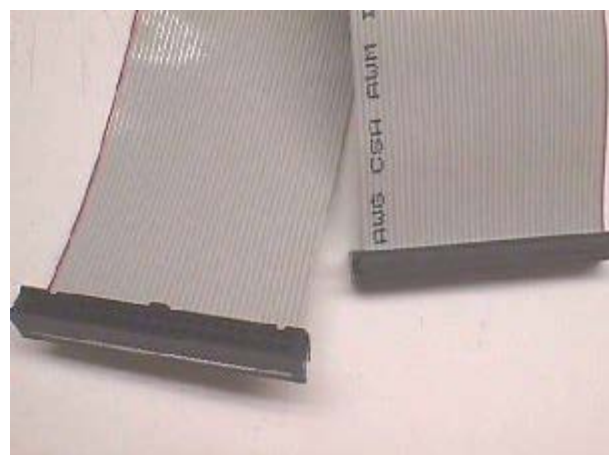




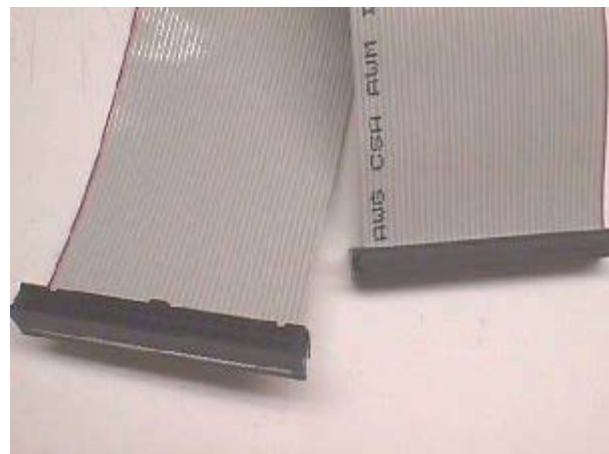




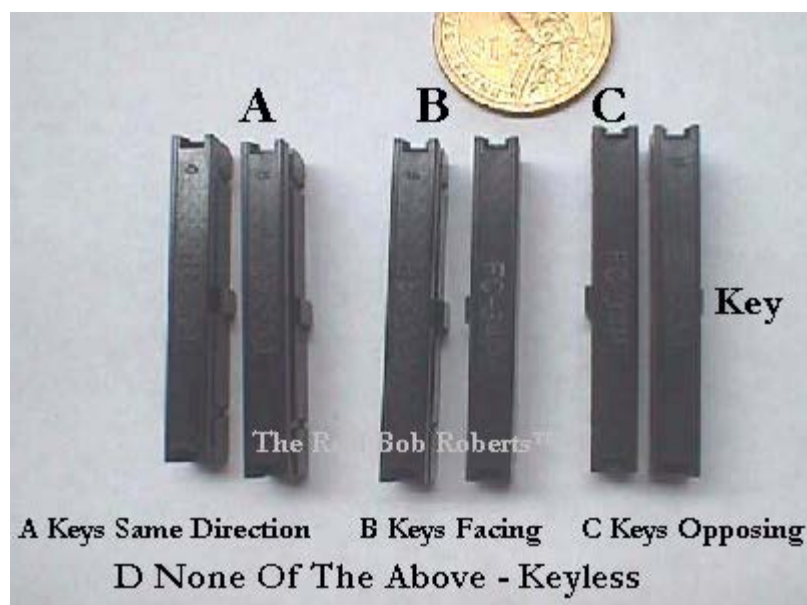




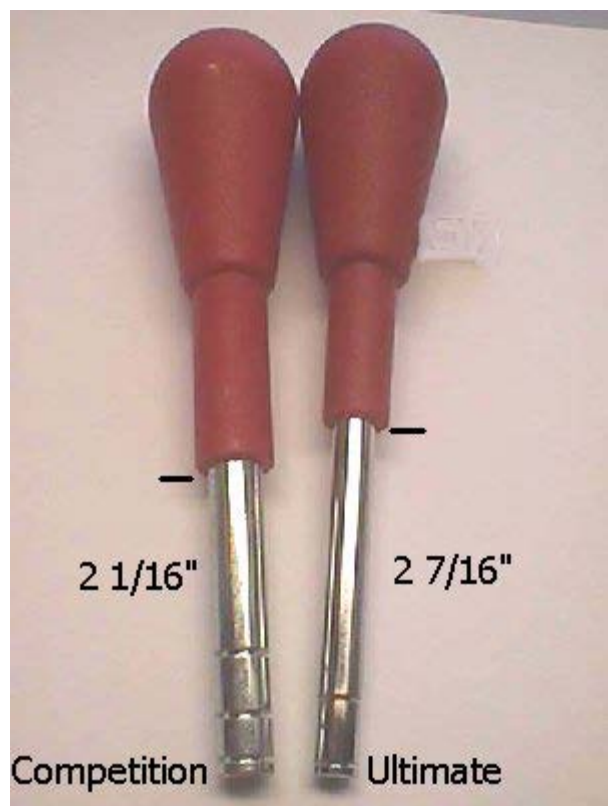
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2 Molex .093 12 position connectors w pins & sockets
1 Bag of 50 .187 QDs fully insulated - CP & maybe spk
6 .250 QDs insulated - coin switches & maybe speaker
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1 Molex .156 IL 6 pos connector w pins monitor (vid)
1 Molex .156 IL 3 pos connector w pins monitor (sync)
1 10' black 22ga wire for switch ground loops
8 Spade connectors for power supply terminals
1 Amp 12 pos connector w pins & socs for coin door





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jp4.jpg %d×%d pixels





jp6.jpg %d×%d pixels





jp8.jpg %d×%d pixels



jp9.jpg %d×%d pixels



Convert An 8-way Ultimate Stick To A 4-way



By Changing Out The Base & Actuator

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jp17.jpg %d×%d pixels







jp14.jpg %d×%d pixels



jp15.jpg %d×%d pixels



jp16.jpg %d×%d pixels



jp18.jpg %d×%d pixels



jp19.jpg %d×%d pixels



jp20.jpg %d×%d pixels









jp22.jpg %d×%d pixels





jp24.jpg %d×%d pixels



jp25.jpg %d×%d pixels





jp26.jpg %d×%d pixels



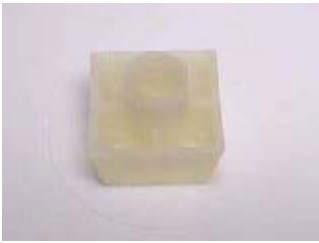
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coinco.jpg %d×%d pixels

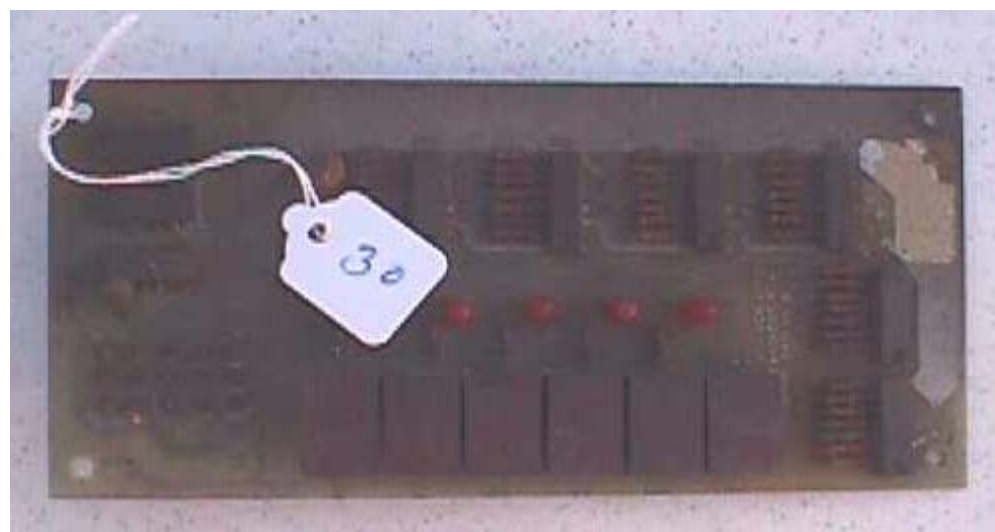


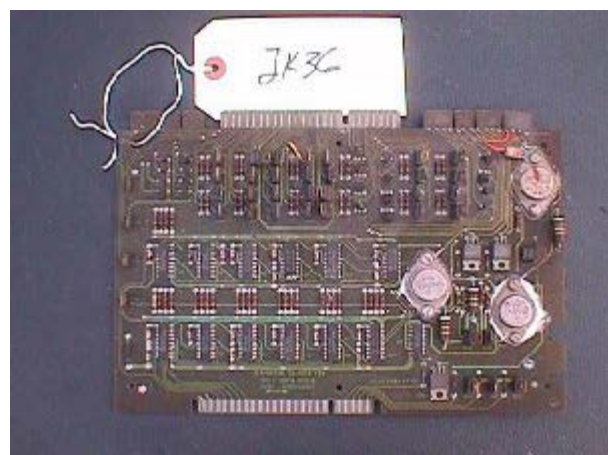


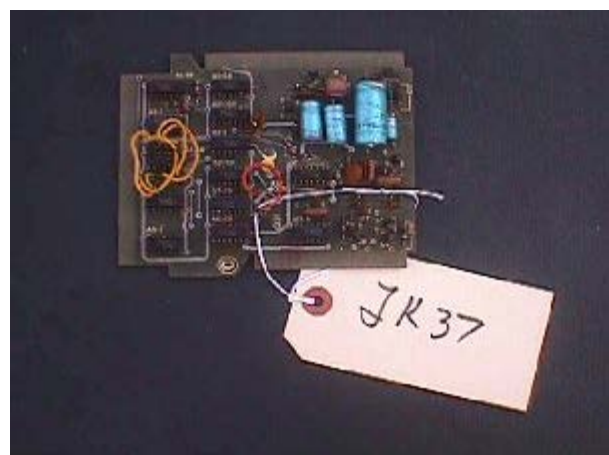
These are new speakers that were used as replacements in juke boxes. There are no 12" speakers left at this time.

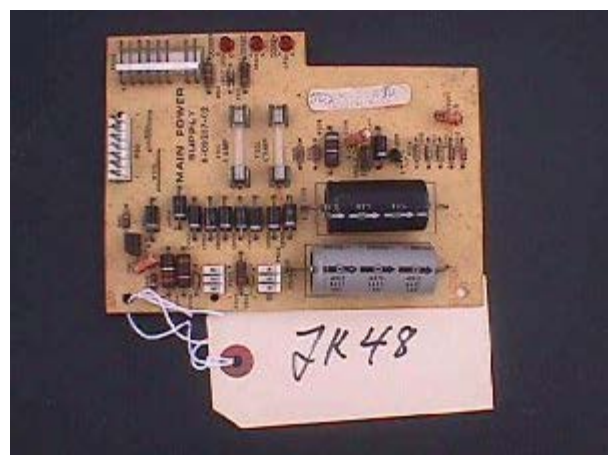
There are 12 of the 10" speakers left. Specs: 8 ohm, 80 watt, 25-5700Hz, 13 oz magnet and the cone is paper with foam surround.

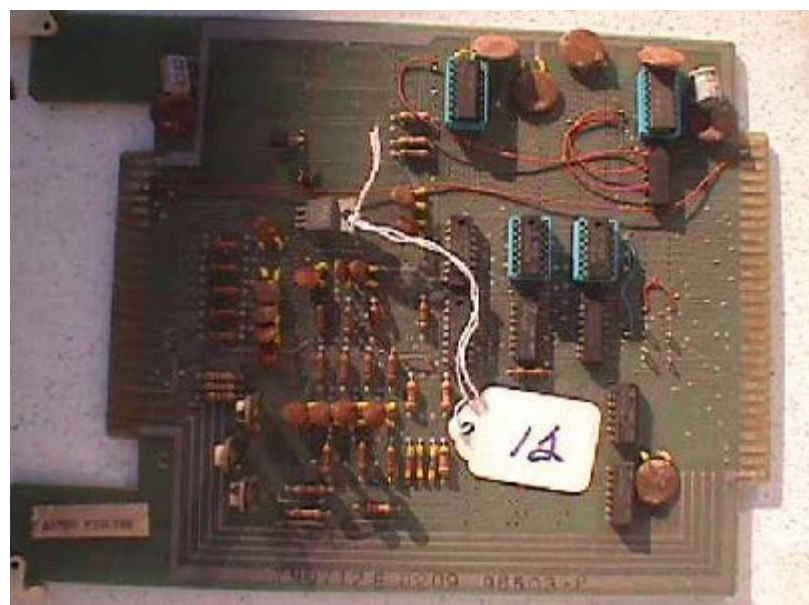






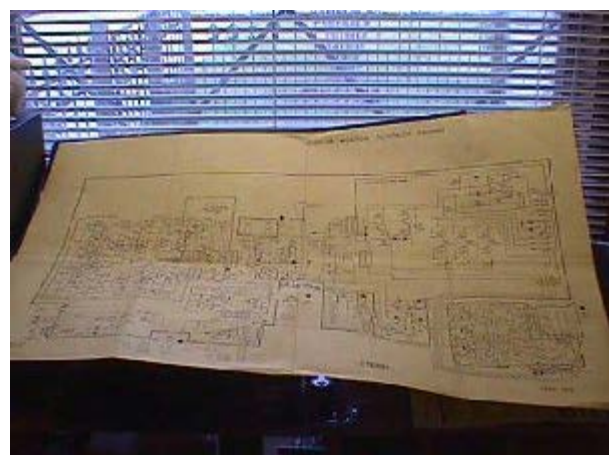




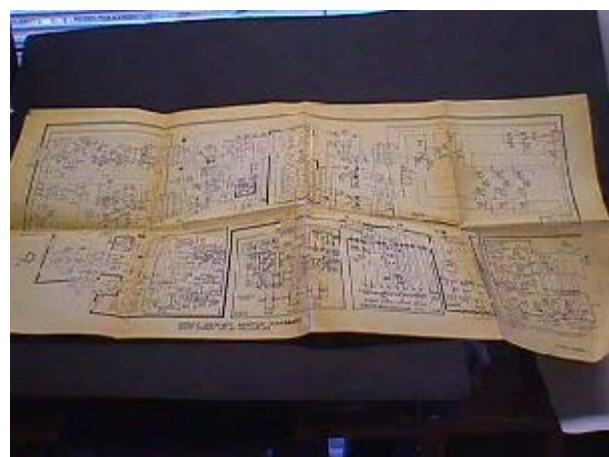






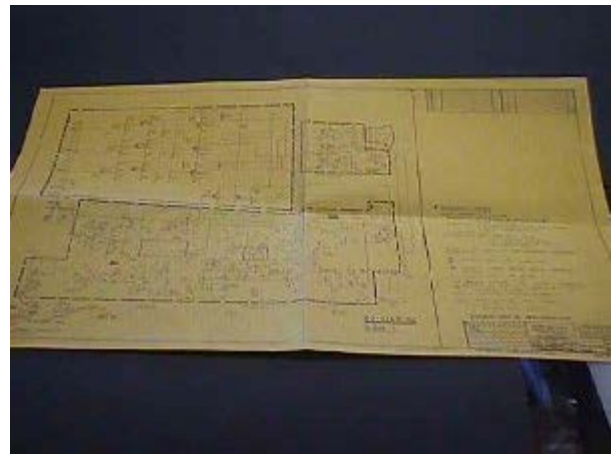




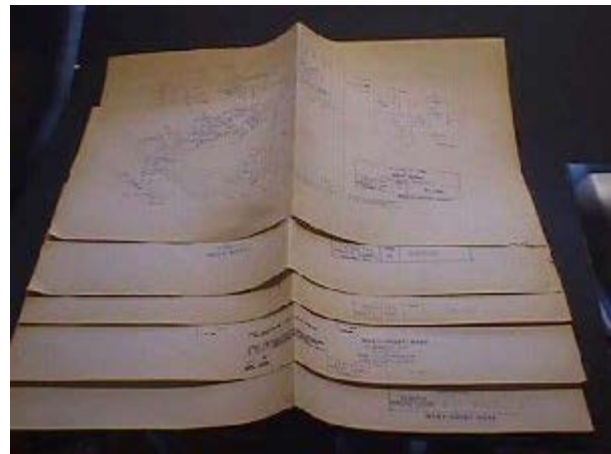


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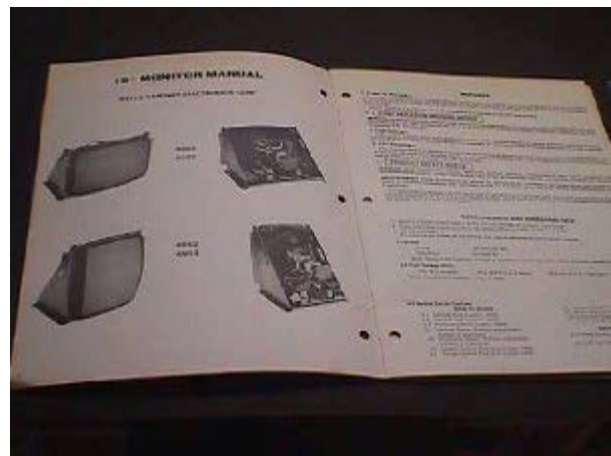




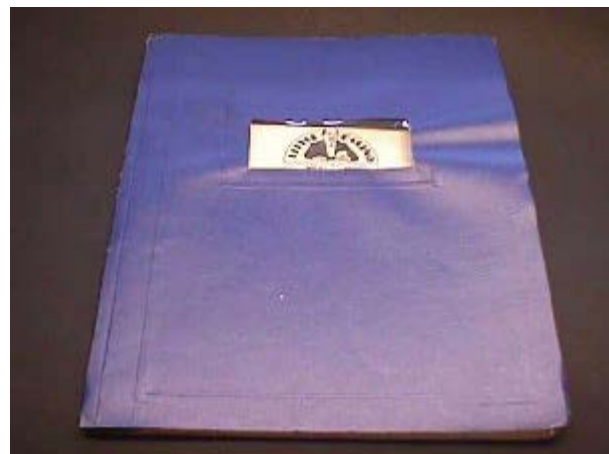


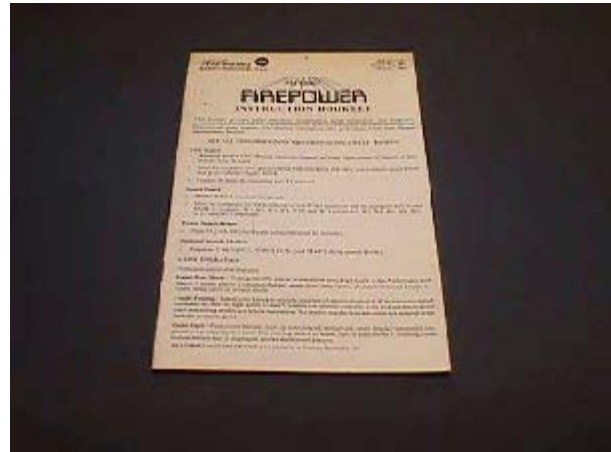
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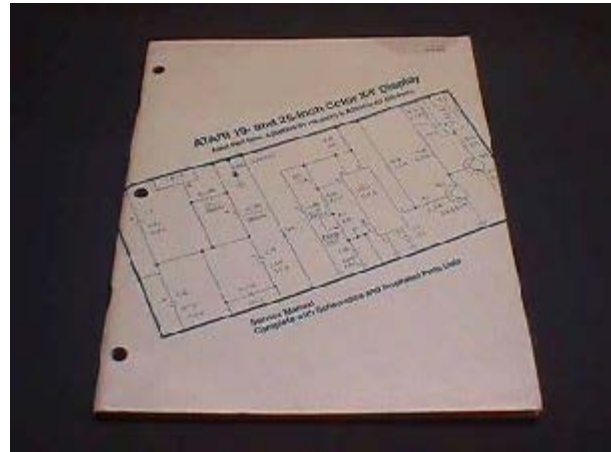


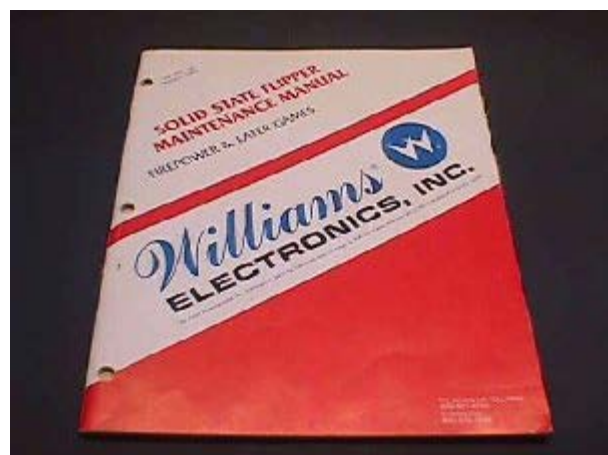


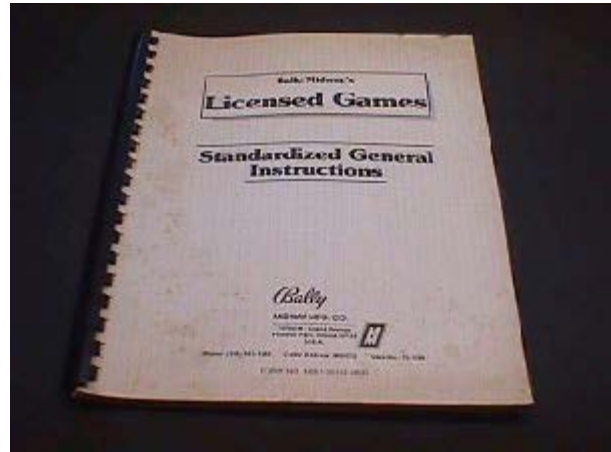




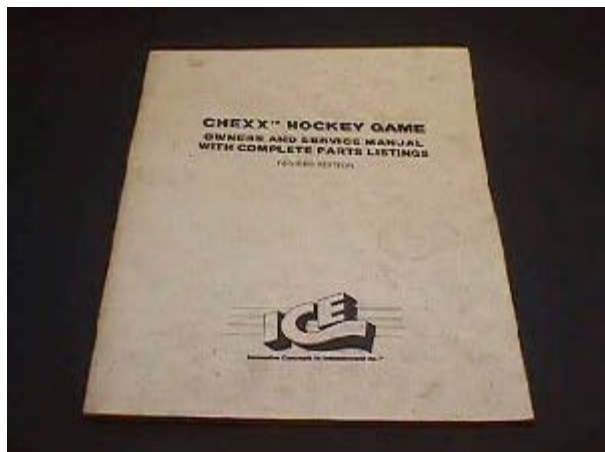




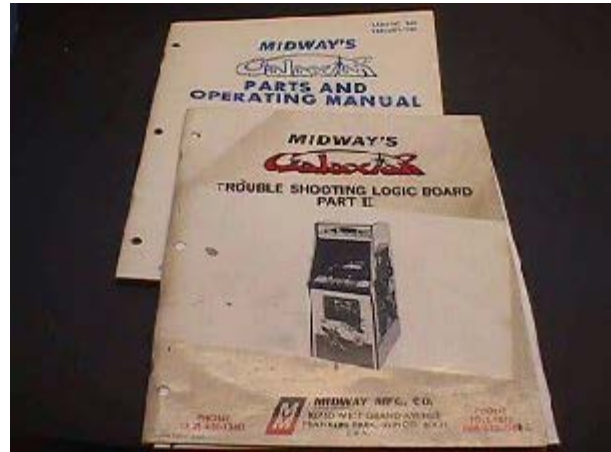




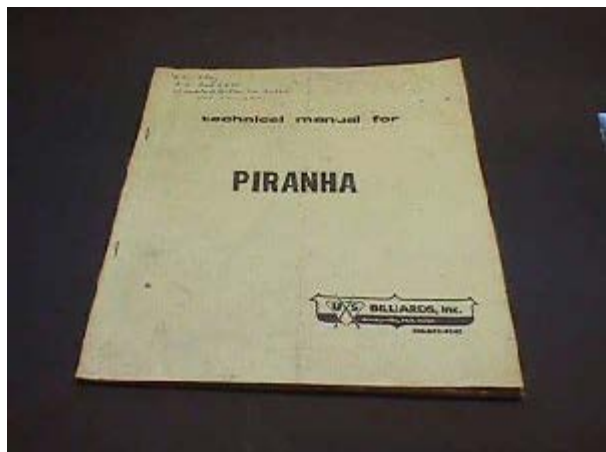


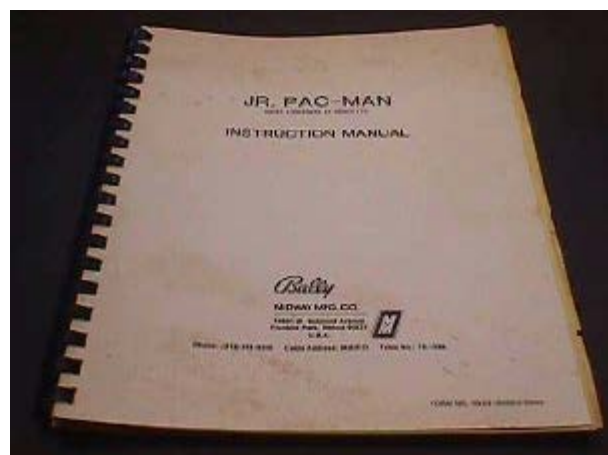


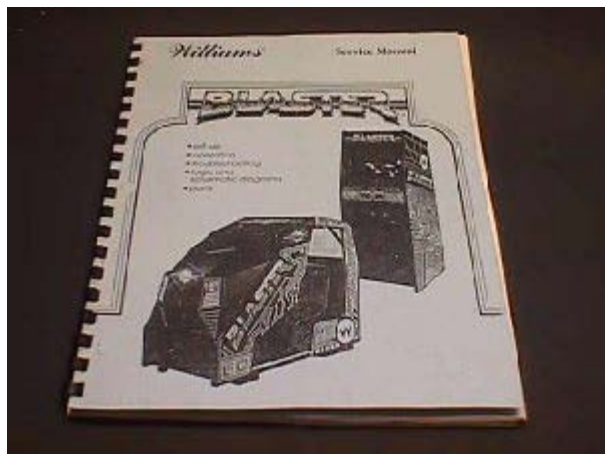










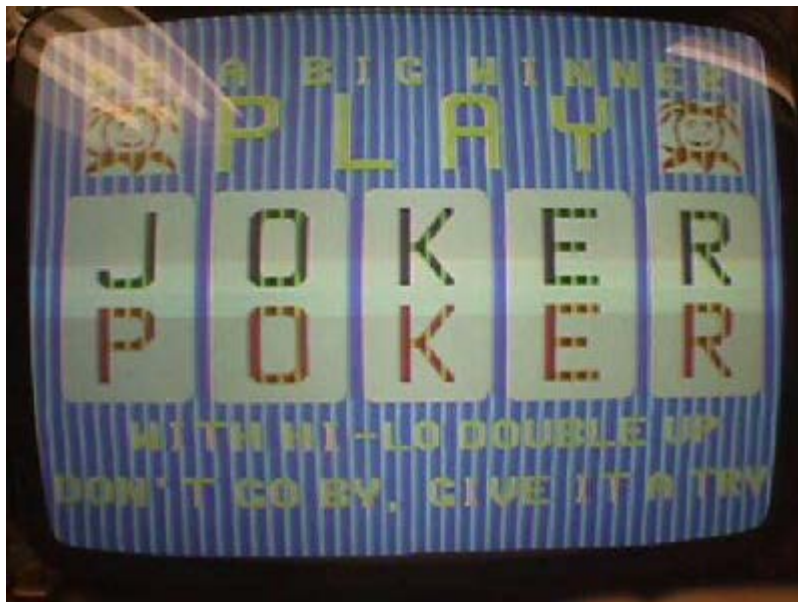


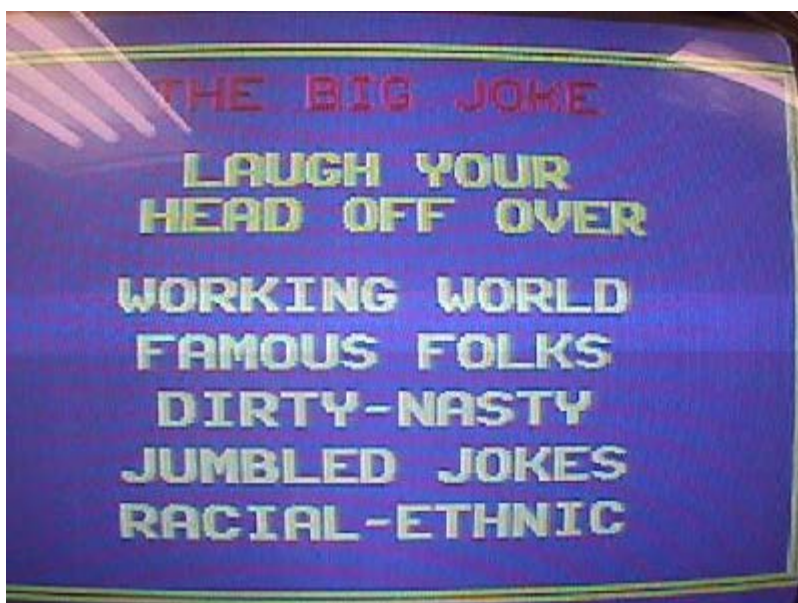


Greyhound Bundle

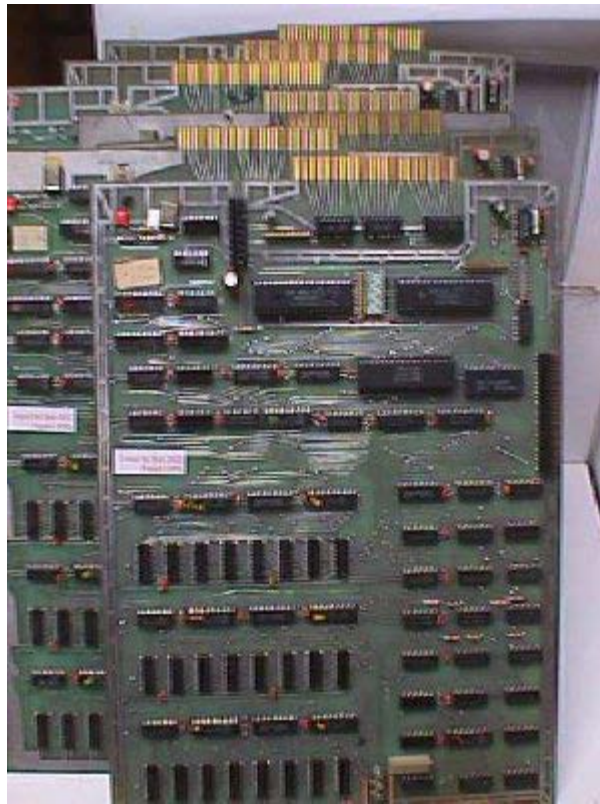
I've rounded up all the Greyhound boards I could find & set up to test them all for an all or none bundle.

Snapped a few screen pics as I went & will post them here:

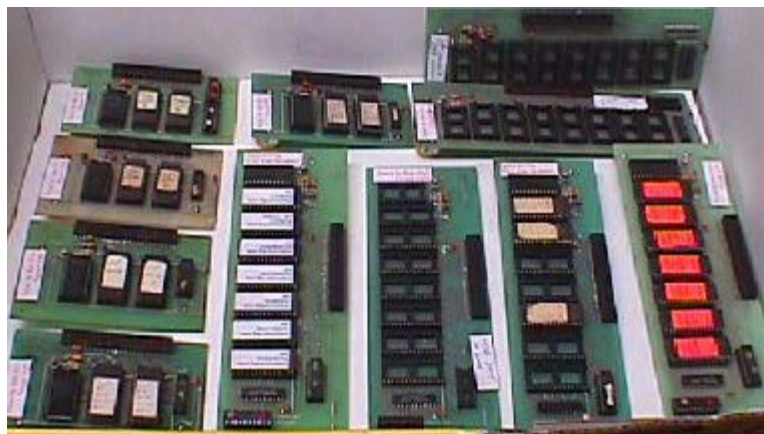




Here's the results of the testing:



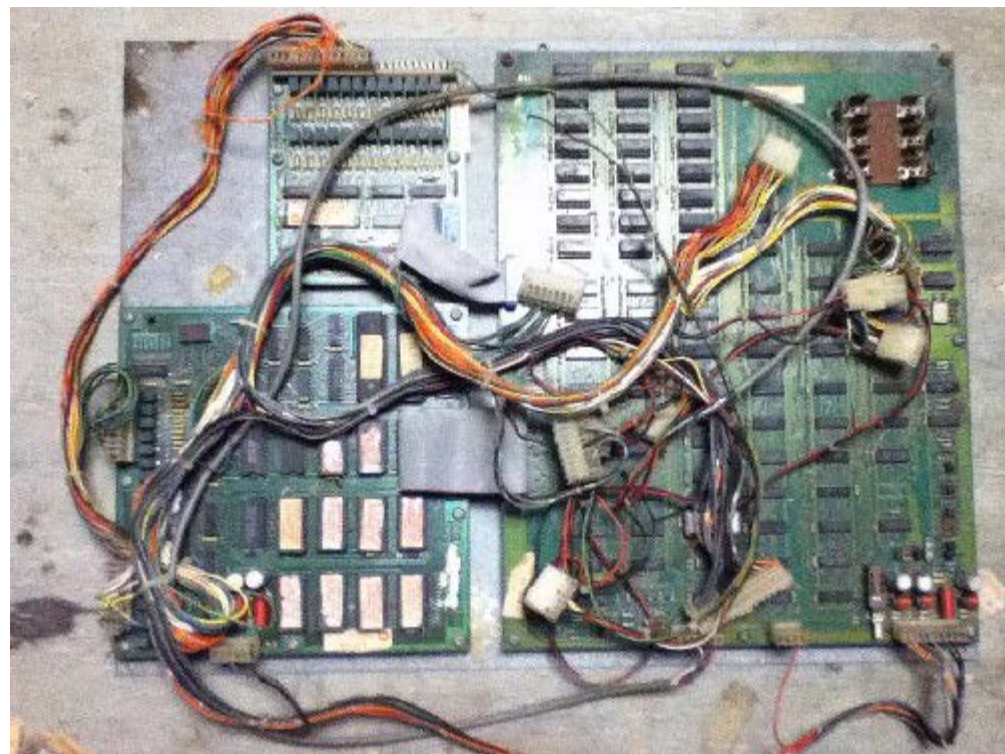
Of the 7 mother boards there are 3 fully working, 2 with vertical lines as seen in pics top of page, 1 that doesn't boot & 1 that is a parts board only.



Of the 11 rom sat boards tested the results are 5 fully working Joker Poker, 1 fully working Black Jack, 2 fully working Big Joke, 1 UVM10-C chip ready [Needs 1 Socket Replaced], 1 UVM10-C Untested Needing A Socket & Battery & 1 Triv3D Works, But Needs Chips.

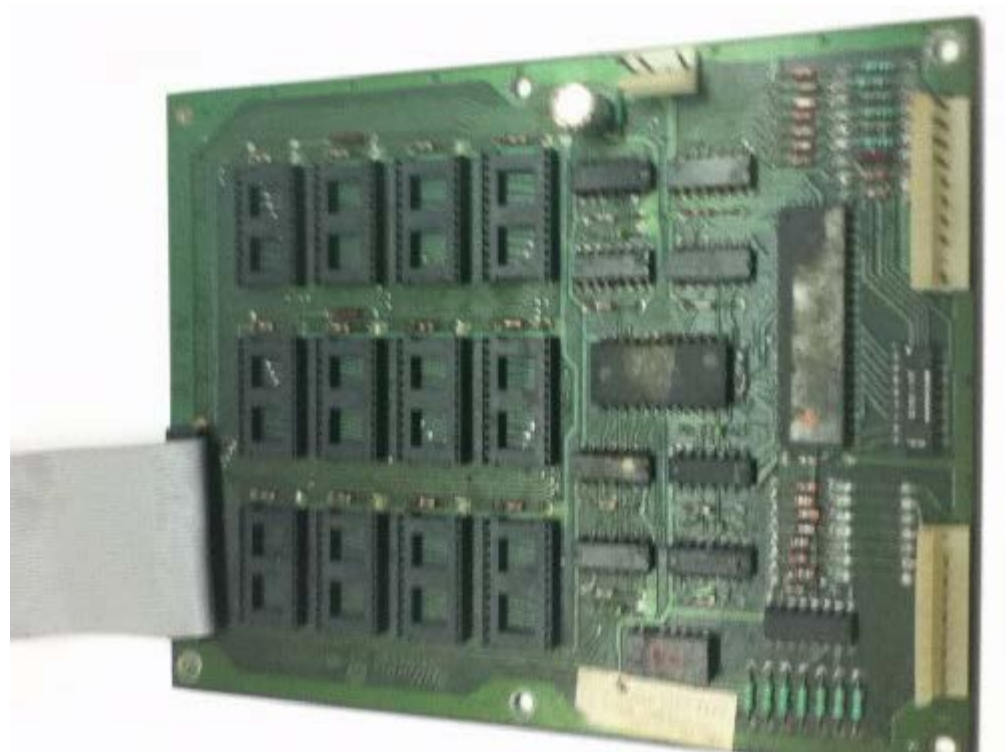
[Here's The Pinout For Greyhound](#)







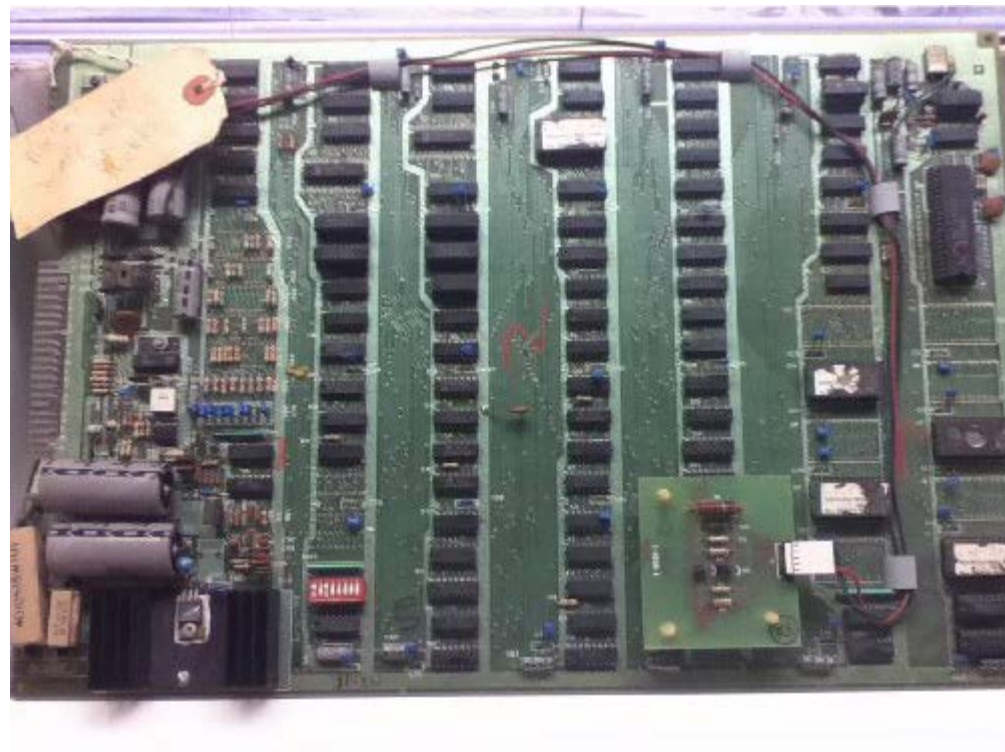






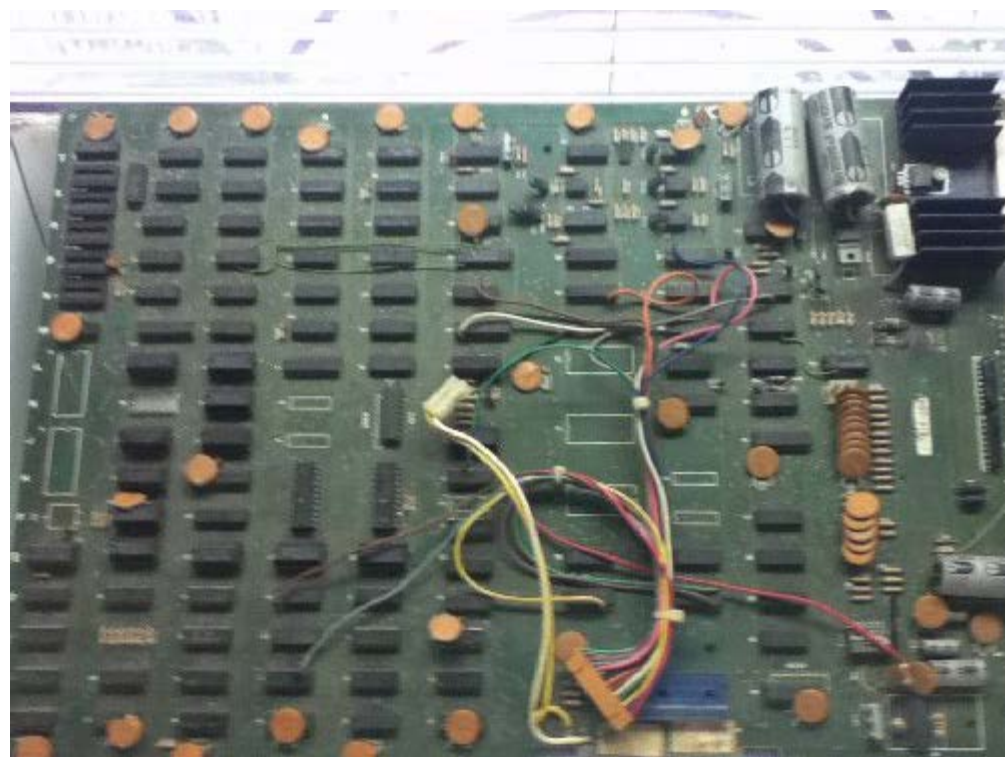


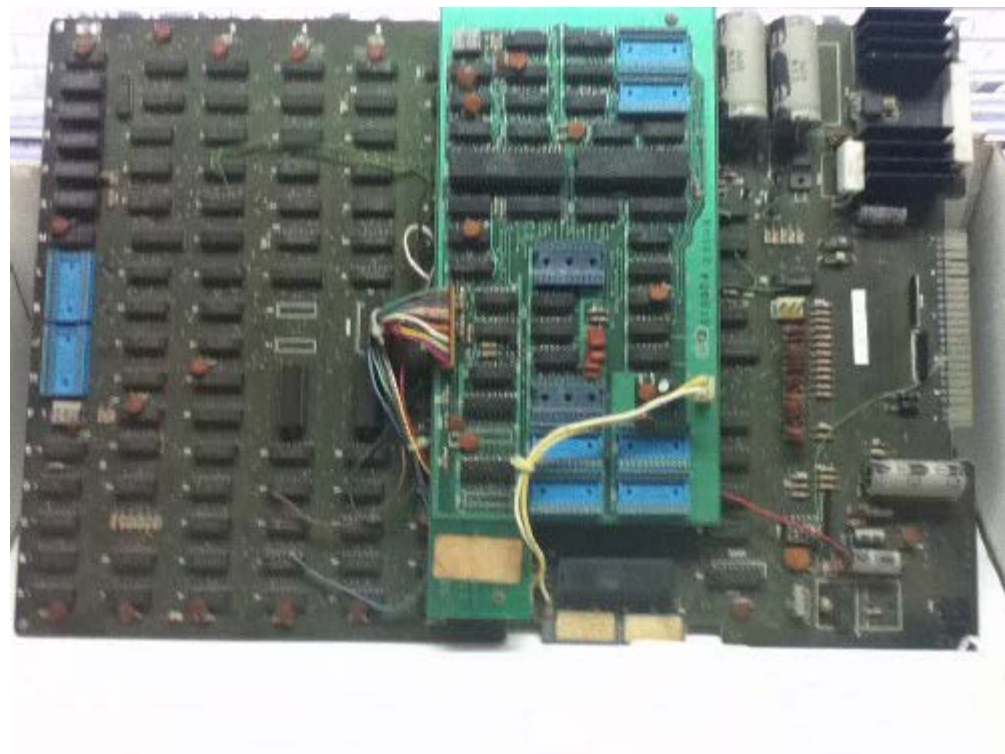


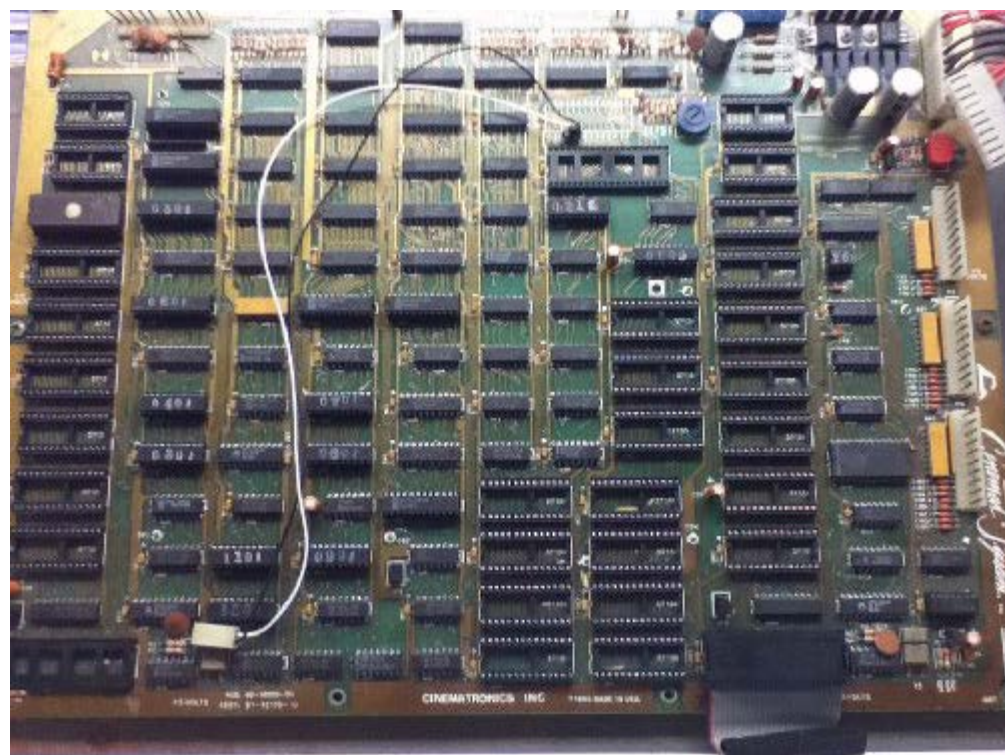




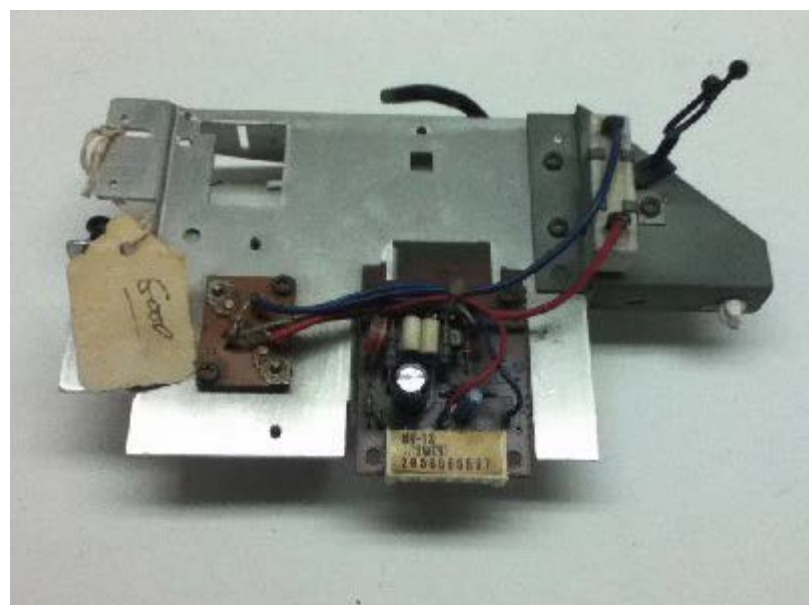










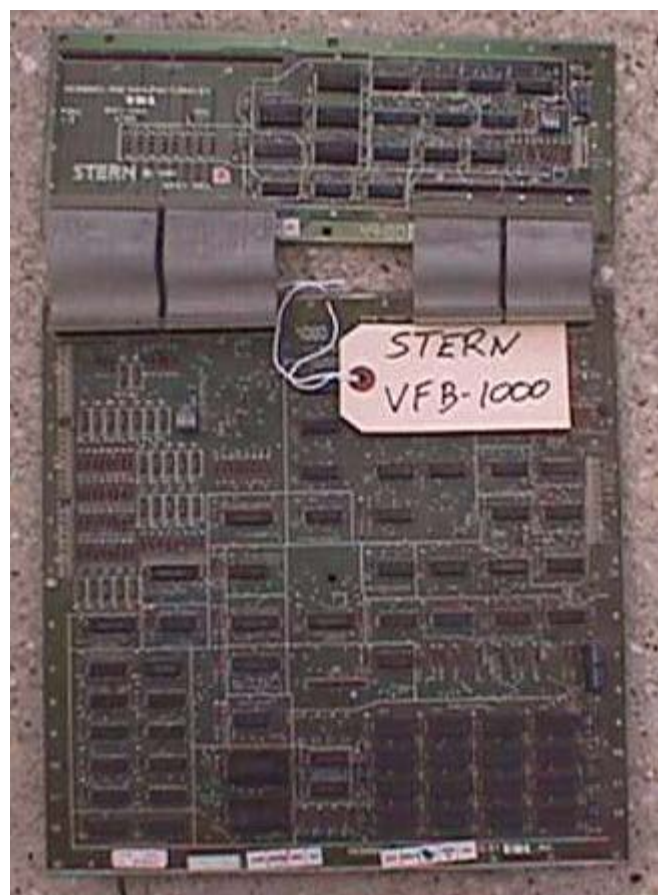


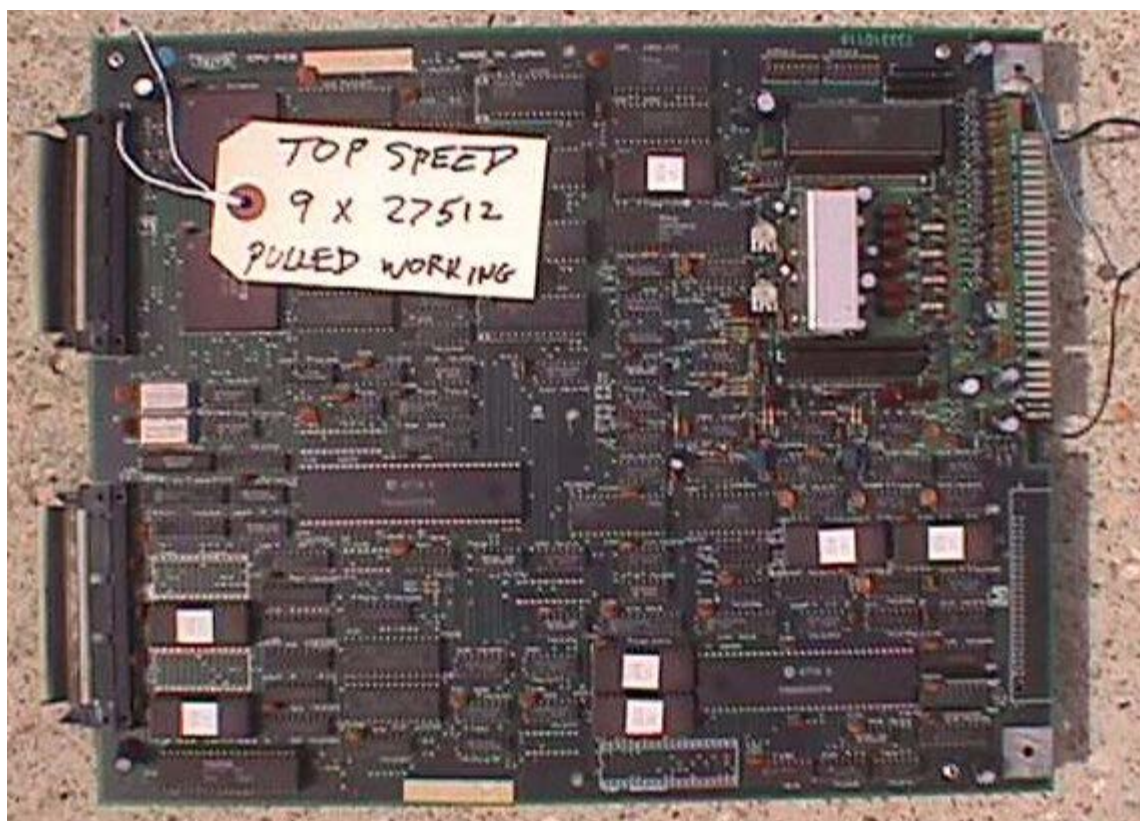
Box of 5 PCBs as-is:

- [Atari 1975 Outlaw PCB](#)
- [Williams CPU PCB](#)
- [K7200 Parts Chassis](#)
- [Pro Wrestling PCB](#)
- [Stern PS-1200 Power Supply](#)













Heatsink used in Taito games w 3 2N3055's

Gottlieb Pyramid Lane Guide Package



Pyramid Package Deal Back
42 Pieces NOS - \$40.00
1½" C15646G x 3
1½" C15646O x 3
1½" C15646Y x 5
1½" C15646R x 6
1½" C15646B x 2
2" C15647G x 3
2" C15647O x 1
2" C15647Y x 1
2" C15647R x 6
2" C15647W x 1
2½" C15648G x 3
2½" C15648O x 3
2½" C15648B x 3
2½" C15648R x 2

Standard Lane Guide Package



Standard Package Deal
61 Pieces NOS - \$50.00
2⅛" OC Yellow Double x 8
2⅛" OC Yellow Single x 11
2⅛" OC Red Single x 9
2⅛" OC White Single x 9
2½" OC Yellow Single x 10
2½" OC White Single x 5
2½" OC Red Single x 9







Misc Pac Parts For Sale

If you're into resurrecting Pac/Ms Pac games this might be for you. I'm looking to sell all the remaining Pac parts that have been traded in. I want to sell this as a lot & not individually. I'm open to reasonable offers. I'll list the contents & then the pics.

- 15 Main Boards
- 13 Auxiliary Boards
- 9 V-Ram Addresser Boards
- 9 Z-80 Sync Buss Controller Boards
- 1 ABC Rom Board
- 1 Pac-man Plus Auxiliary Board
- 6 Sets Of Roms

[Pac 1](#)

[Pac 2](#)

[Pac 3](#)

[Pac 4](#)

[Pac 5](#)

[Pac 6](#)

[Pac 7](#)

[Pac 8](#)

[Pac 9](#)

Jukebox Wall Box



Clean Them Up To Use In Your Game Room.
These Wall Hangers Are Great Conversation Pieces.



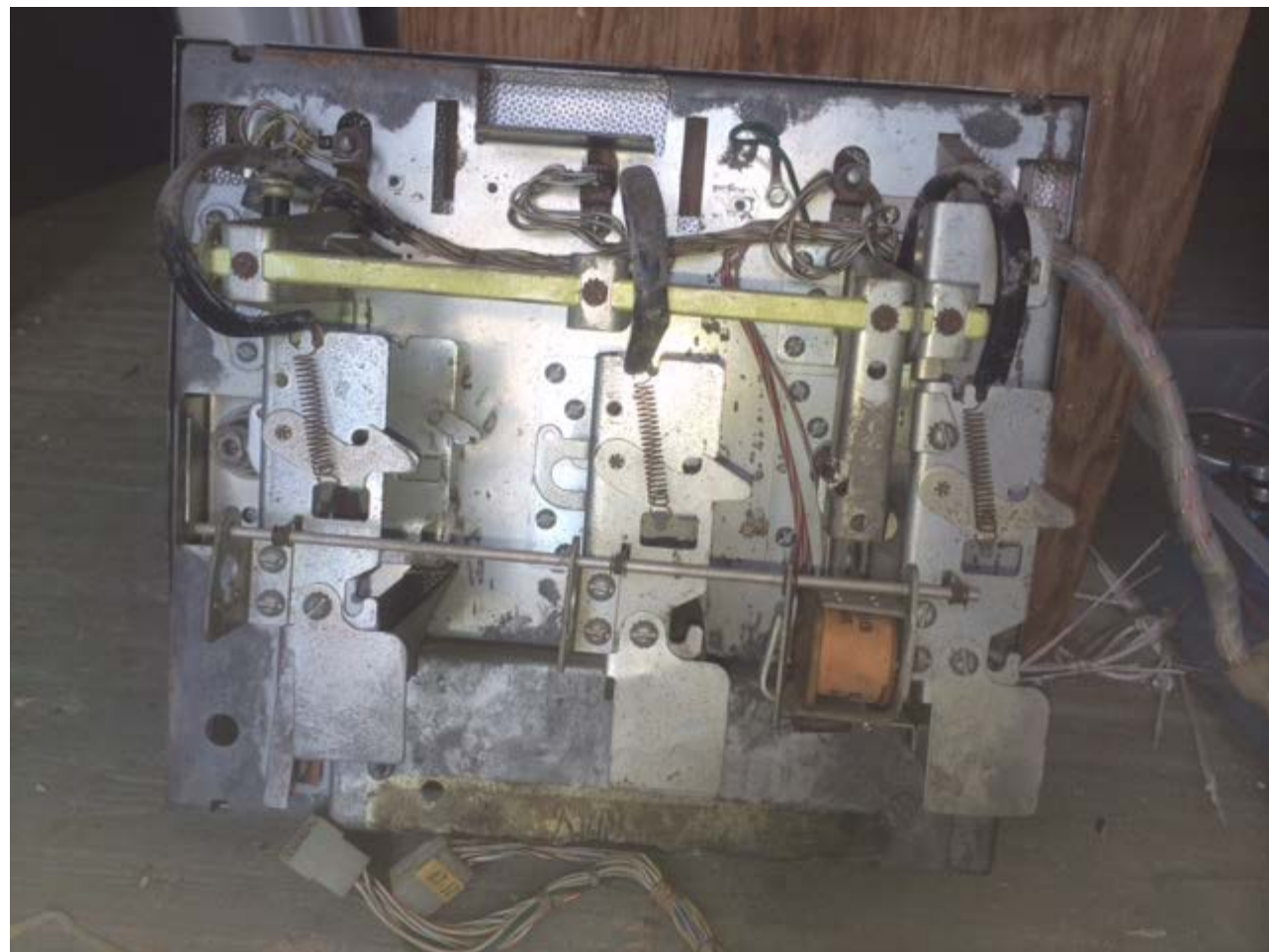


























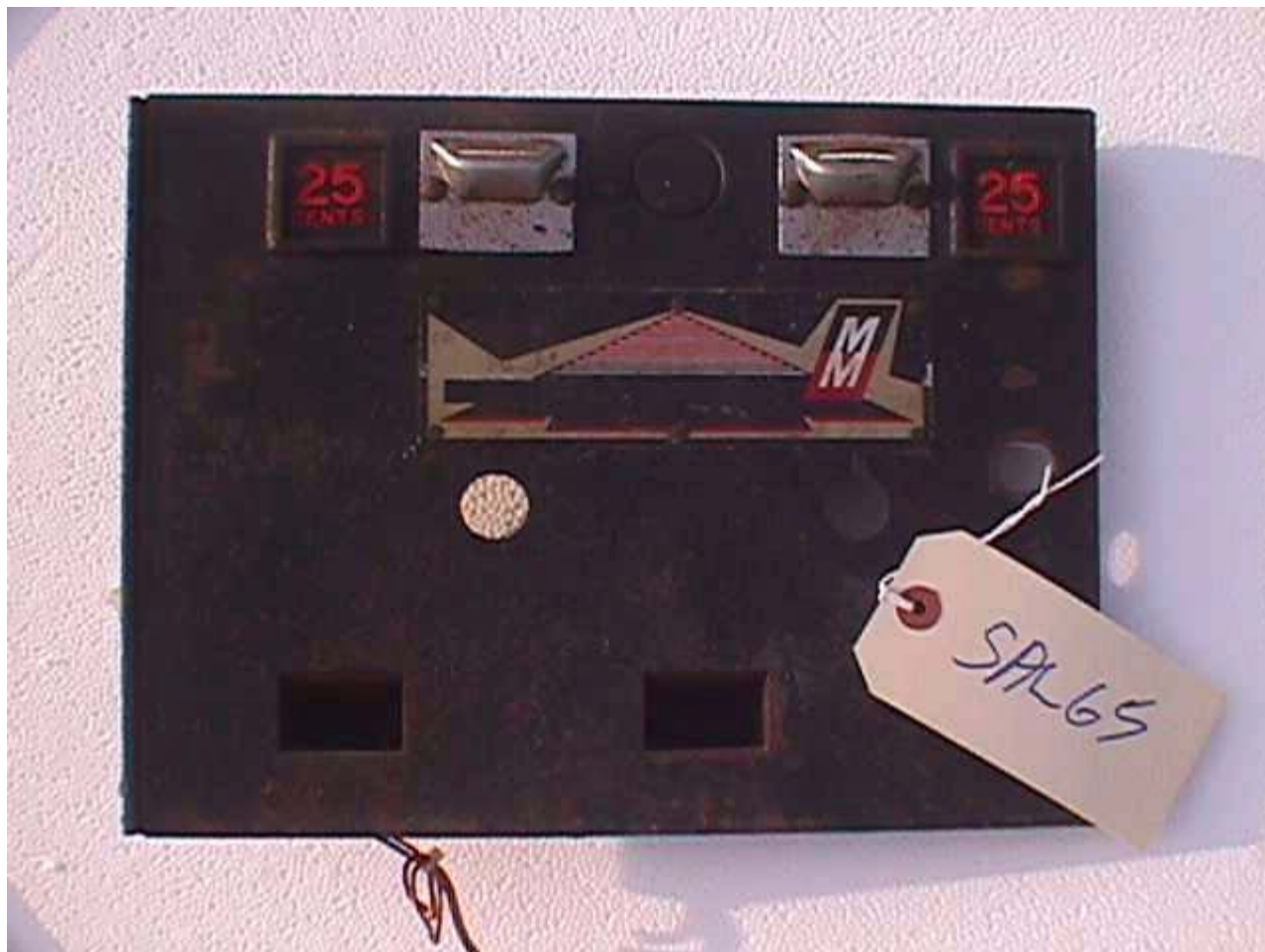


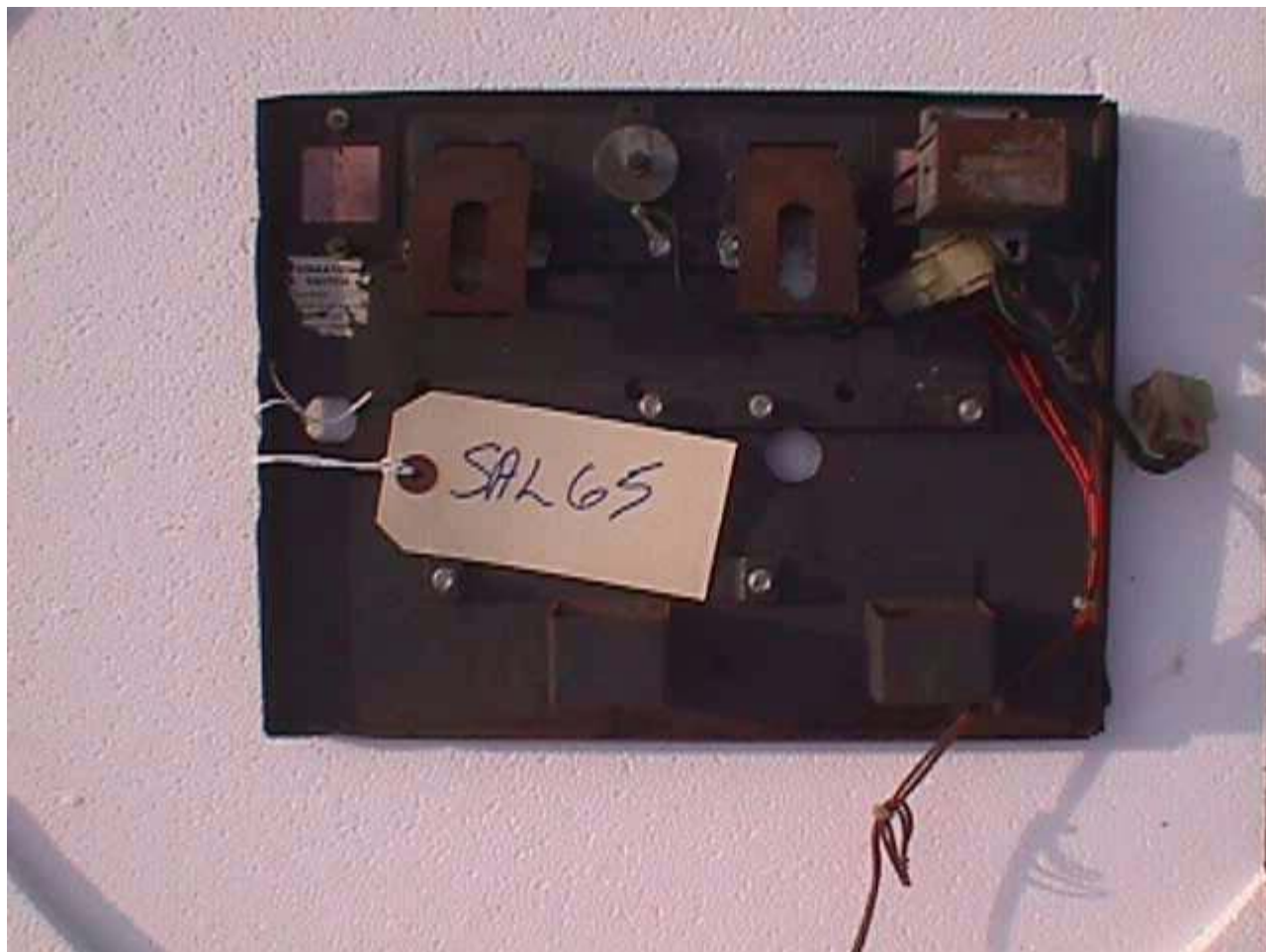




**Screw base - uses Nite Lite bulb & can be mounted
to back light your project.**









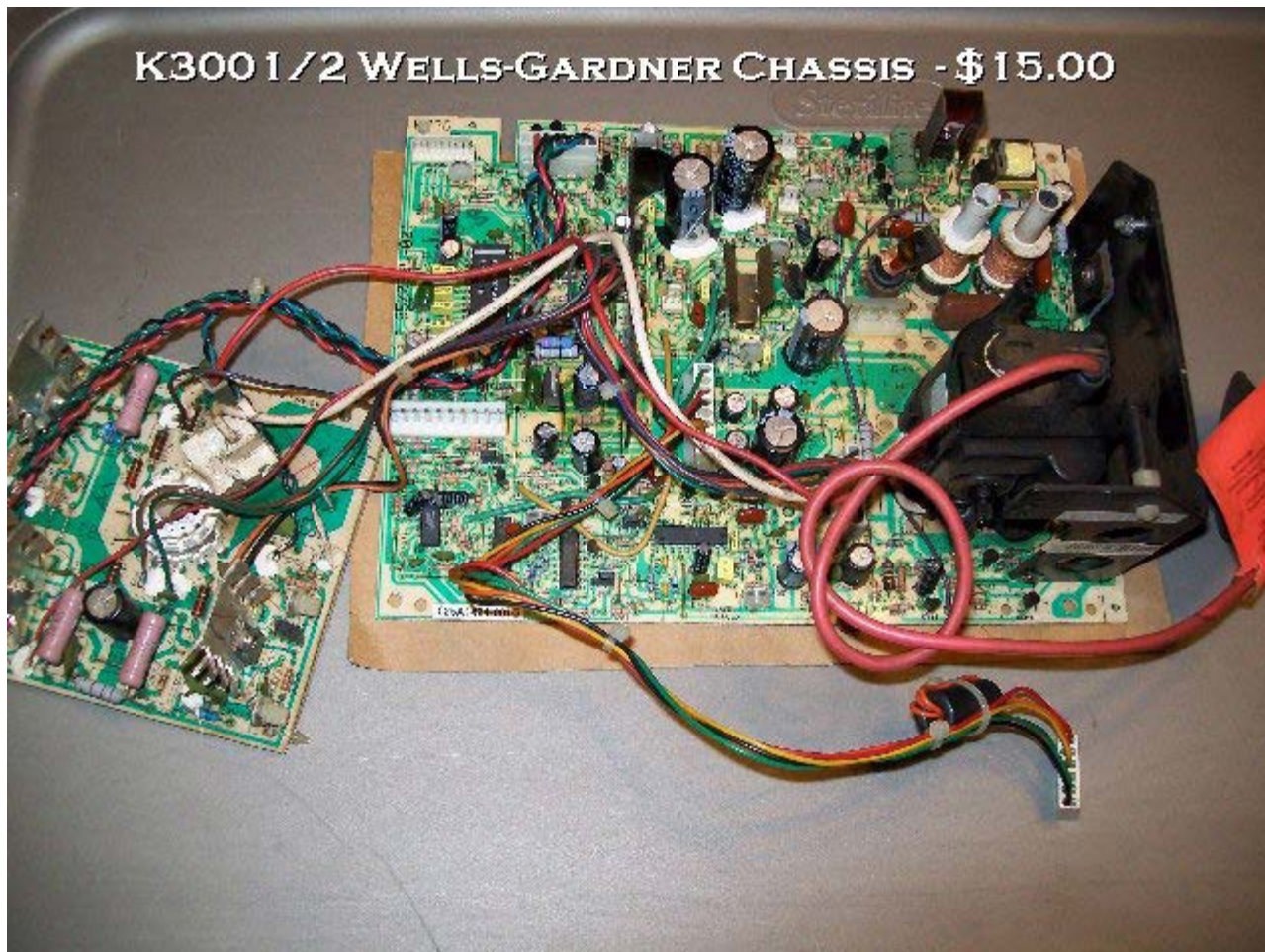








K300 1/2 WELLS-GARDNER CHASSIS - \$15.00





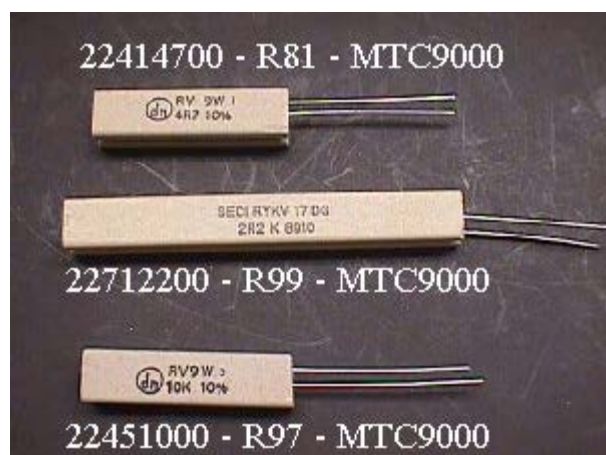
















spec69.jpg %d×%d pixels









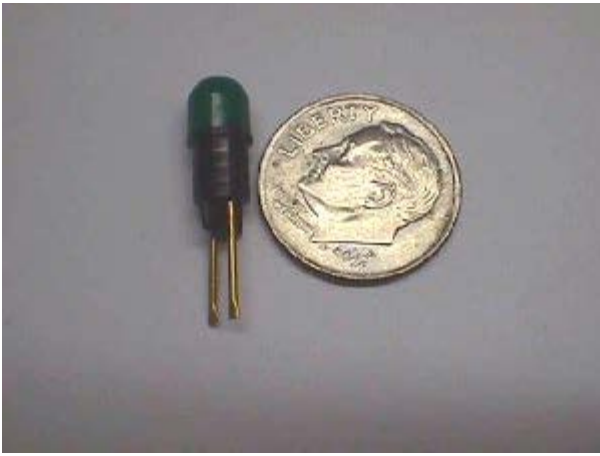
Drawer Pulls & Hardware
Removed From New Equipment

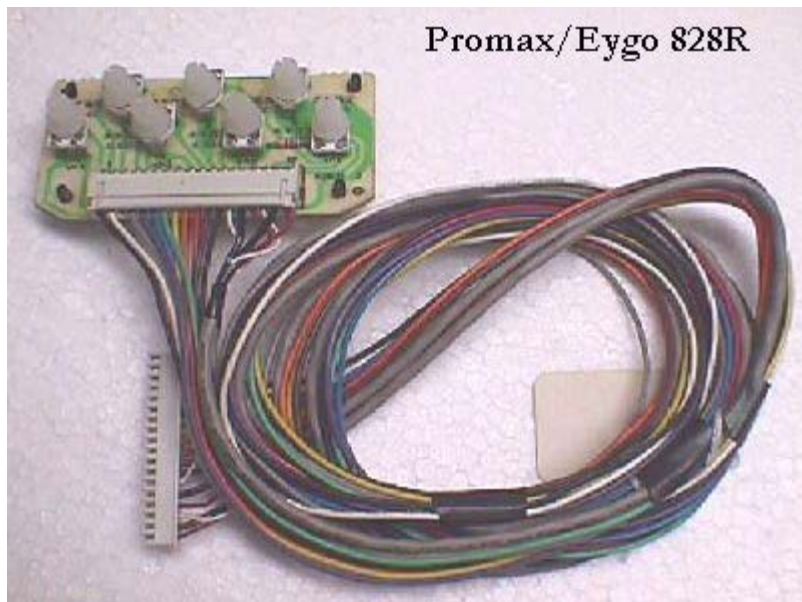


These Were Used To
Fasten Speaker Box Grilles
But Could Be Used
For Many Other Apps







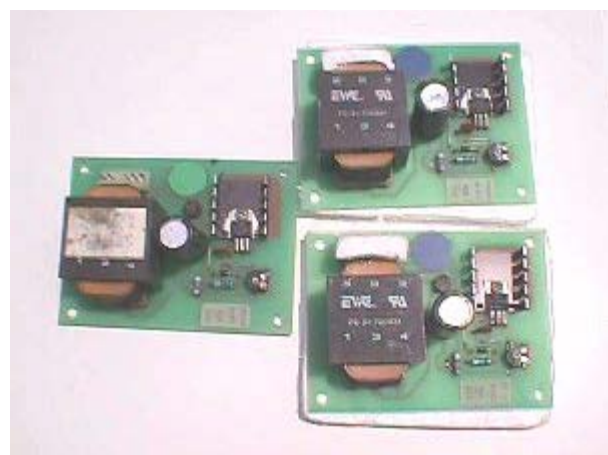










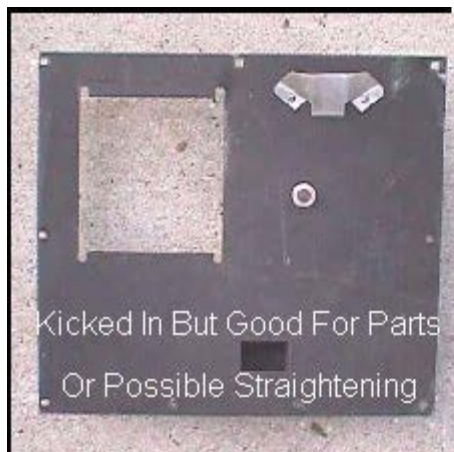




I finally took a few minutes to go through one of the bins of coin windows & sort out like pairs. I'll list the pairs below by the stamped part number & price them per pair.

Part Number	Price
13C-2-50 2 Quarters 1 Play	\$5.00
08-20005A 1 Play 1 Quarter	\$6.00
08-20006A 2 Plays Quarter	\$6.00
08-20004A 1 Play 1 Quarter 3 Plays 2 Quarters	\$6.00
C-826-57 1 Play Quarter	\$6.00
C-826-50 2 Plays Quarter	\$6.00
C-826-61 1 Play 1 Quarter 3 Plays 2 Quarters	\$6.00
C-826-139 2 Quarters 1 Play	\$6.00
C-826-164 1X25=1 2x25=3 3x25=4 4x25=7	\$5.00
C-826-119 1 SBA Dollar 4 Plays	\$5.00
C-826-113 1 Dollar 7 Plays	\$5.00
C-826-122 1 SBA Dollar 7 Plays	\$6.00







spec18.jpg %d×%d pixels























Wiring Your Pac Cabinet

by Bob Roberts

Chapter 2 - Into The Cabinet

It's a beautiful day... just the right amount of sunshine... and it's cooled down to a pleasant 92 degrees, so I'm moving this project outside.

Here's the old empty Ms Pac cab that has been waiting around all these years for some new wiring.



I had mentioned that the "power center" could be mounted anywhere in the cab that you had room for it, so I'll tack it in a couple different places for illustration.



This is the typical Louisiana flood level control mounting.



You can see that up to a foot of water wouldn't even slow this Ms Pac down. Of course, the player would need his rubber boots :-)



When the flood water is 4 feet high & rising more drastic measures are needed. Here's a high water installation that can even be plugged into a ceiling outlet allowing water as high as the monitor chassis. Forget the boots... don't try playing it, just be glad it'll still play after the water ebbs.



I'm going to just drop this "power center" into the cab bottom for this job, for ease in pic taking. You can mount it facing in just about any position that is convenient for you.

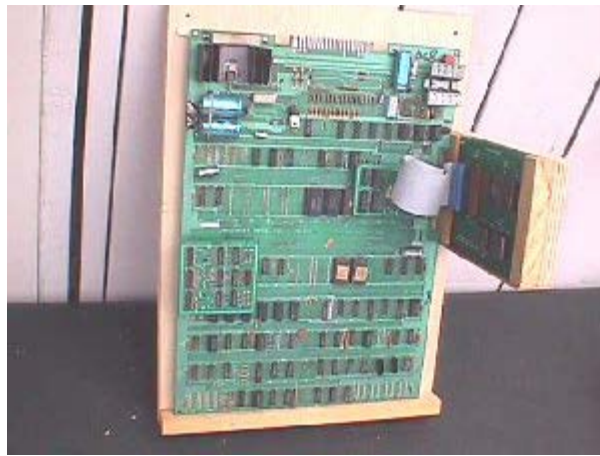


A 1/4" cable clamp will hold the ac line cord in place just in case someone decides to drag the game around via the cord, but it is not necessary & adds one more step to the quick removal process for t-shooting.

Before doing any permanent wiring you'll need to decide where & how you want to mount your game bd. There are limitless ways to mount from using PCB feet to mounting on slide-in interchangeable panels. I used a lot of cheap strapping from Home Depot for stays. You can rip it in half & drill holes through it in 2 directions & screw it into any weak cab corners for bracing, as well as, cutting a slot in it to hold PCBs. Here's a pic of an assortment of small stays.



I'm going to mount the Ms Pac bd on a piece of plywood in a fashion similar to that of the "power center" using stays. Again, much easier to remove complete for any future t-shooting.



A piece of 1/2" or 5/8" BC plywood would work fine for this, but I had a piece of scrap cab ply just the right size, so I used it. The main bd is craddled in a stay at the bottom & fastened at the top with 2 PCB feet. I fastened another piece of scrap ply on a 90° & added stays to loosely cradle the auxiliary bd.



A scrap piece of thin paneling across the bottom keeps the auxiliary bd from sliding right through & the ribbon cable will keep it from sliding out the top when the cabinet is moved.



Putting a strip of plywood on the cab bottom in front of the premounted bd will hold the bottom in place & 2 screws easily fasten the top. Should the bd need to come out some time in the future, simply unplugging the edge connector & removing the 2 screws will allow it to be worked on at the

service bench... instead of being a backbreaking job.

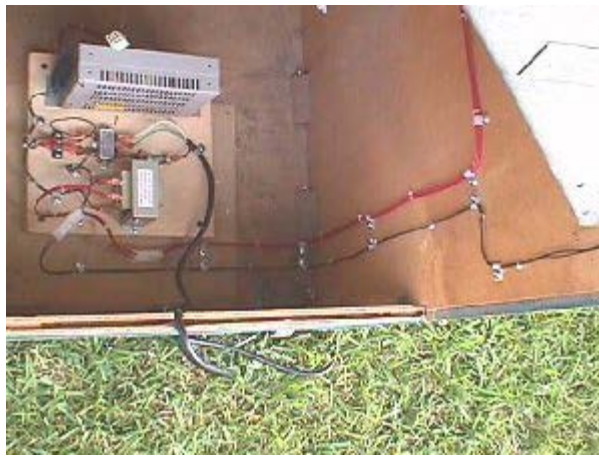
With the 2 main components mounted it is safe to go ahead & finish the permanent AC wiring. The monitor isolated power line is an easy one... continuation of the two 18ga red wires from the "power center" up to the AC entry point for the monitor.



Simply measure the length you need, add the mating Molex 2 position receptacle on one end & the plug on the other... should be like an extension... cable tie the pair together & then fasten to the wall of the cab with cable clamps.



Adding the AC on/off switch line is next. This is where I use the pair of 18ga brown wires. Measure them from the power center plug to wherever you want your on/off switch to be located. I'm going to use one of the pre-mounted on/off switches in the existing AC switch hole in the top. I've cable tied the pair of wires together, crimped on a pair of .25 QDs & hooked them up before mounting.



In cable clamping the switch line I ran it parallel for this demo, but you can join pairs together that are following the same route.



The switch line goes straight up the cab side to the mount.



Leave a little slack at the top & you can use all 4 screws in the mounting plate, although, I've never had a problem using just 2.

K... the only thing needed now is the switched AC power to light the marquee fluorescent. I've measured out a pair of 18ga blue wires & cable tied them

together, added a Molex receptacle on the end for the marquee area & a pair of .25 QDs for the power distribution block.



As I said before, all these lines can be combined & rather than run yet another cable clamped line I'm going to piggyback the switch line.

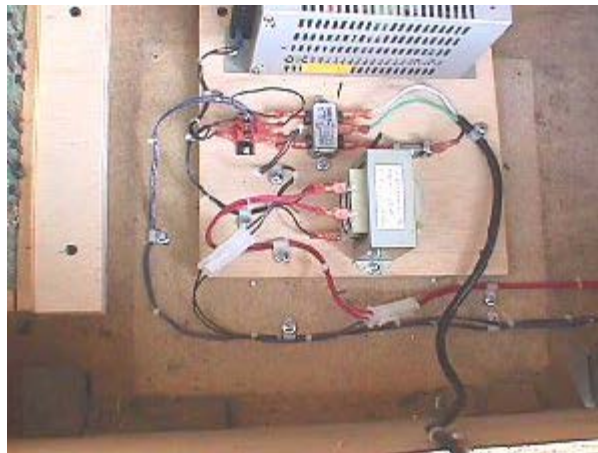


Once you pass the switch & branch out in to the marquee area you'll need to resume cable clamping to the outside cab wall.



Using 3/8" cable clamps all 3 pair could easily be combined into one harness.

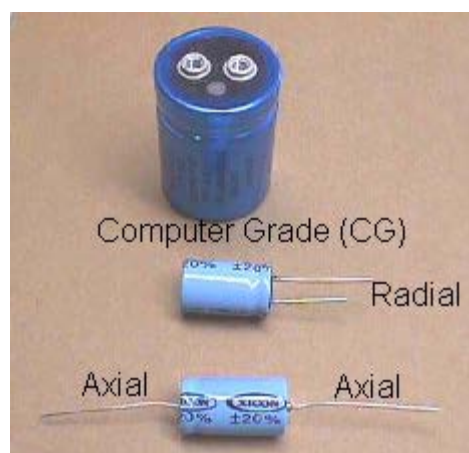
Note: If one size cable clamp is too tight & pinching your wires, and moving up to the next size you find your wires are too loose & don't want to stay where you want them, you can secure them in place by putting a cable tie on either side of the clamp to prevent them from moving.



That's it! Switched AC power has been set into the cab. These same principles would apply no matter what game you were building.

[Next Chapter... DC Wiring ...](#)

Happy Gaming...



fbt.jpg %d×%d pixels



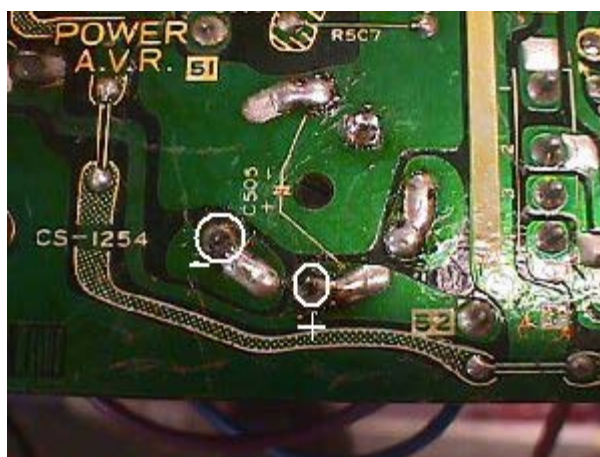
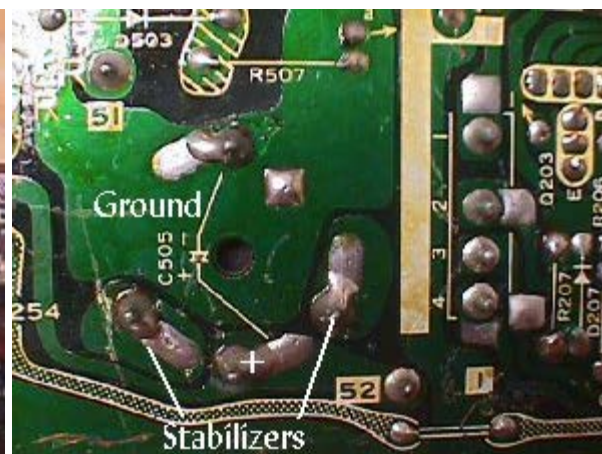


Using A Crimper

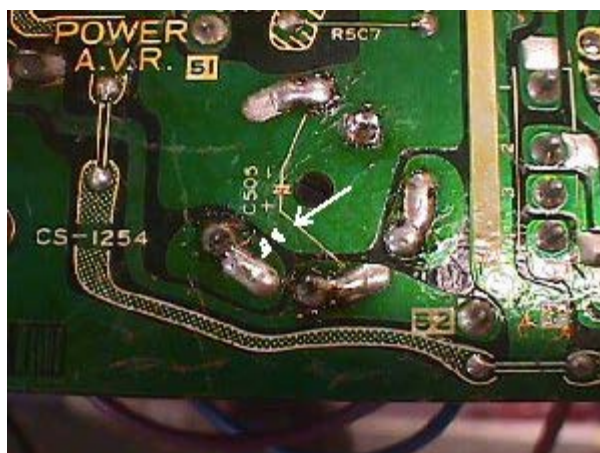
WG K4900 Chassis

Changing The Filter Cap

by Bob Roberts

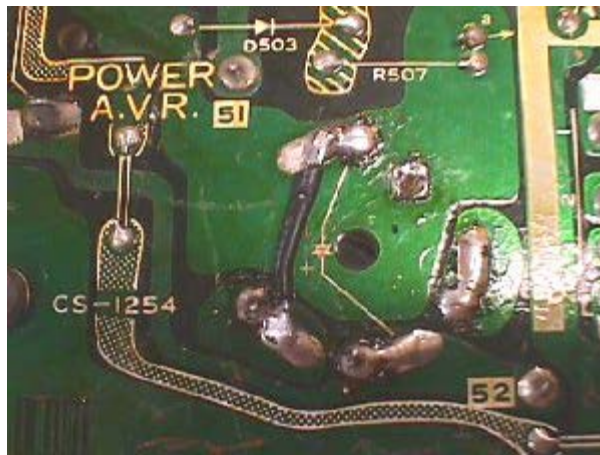


To get the best fit for the new smaller cap on the K4900 chassis it is necessary to use one of the neutral stabilizer pads for the negative side. I've circled the two holes that should be used.



You'll need to join the neutral pad used for the negative terminal to the chassis ground pad. A quick fix is to scrape the insulation off the traces where they are in close proximity & join them with a

bead of solder.



Another way to join the neutral pad to ground is with a piece of wire.

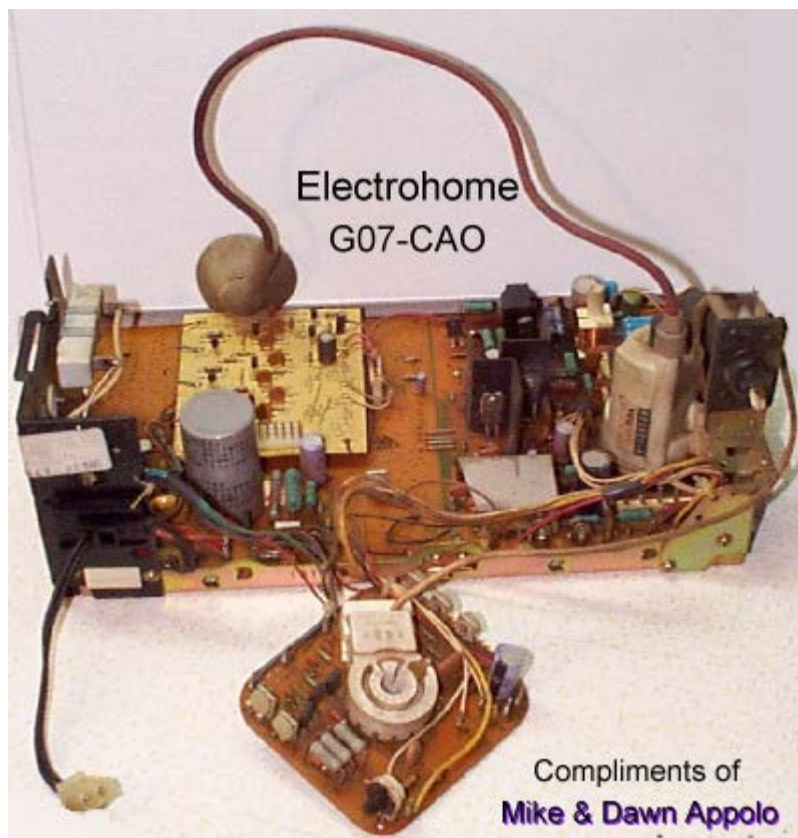


This one gains enough real estate to put a tennis court in or at least a small pool :-)

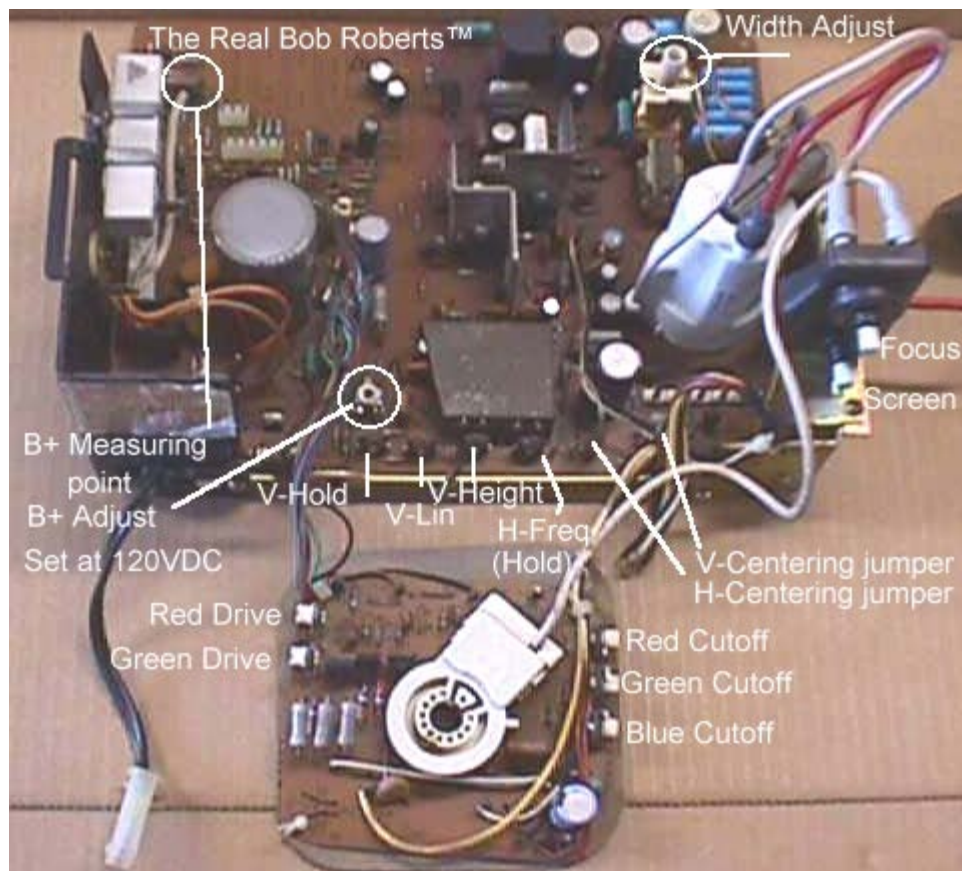
Happy Gaming...

Using A Crimper





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[Cap Map](#)

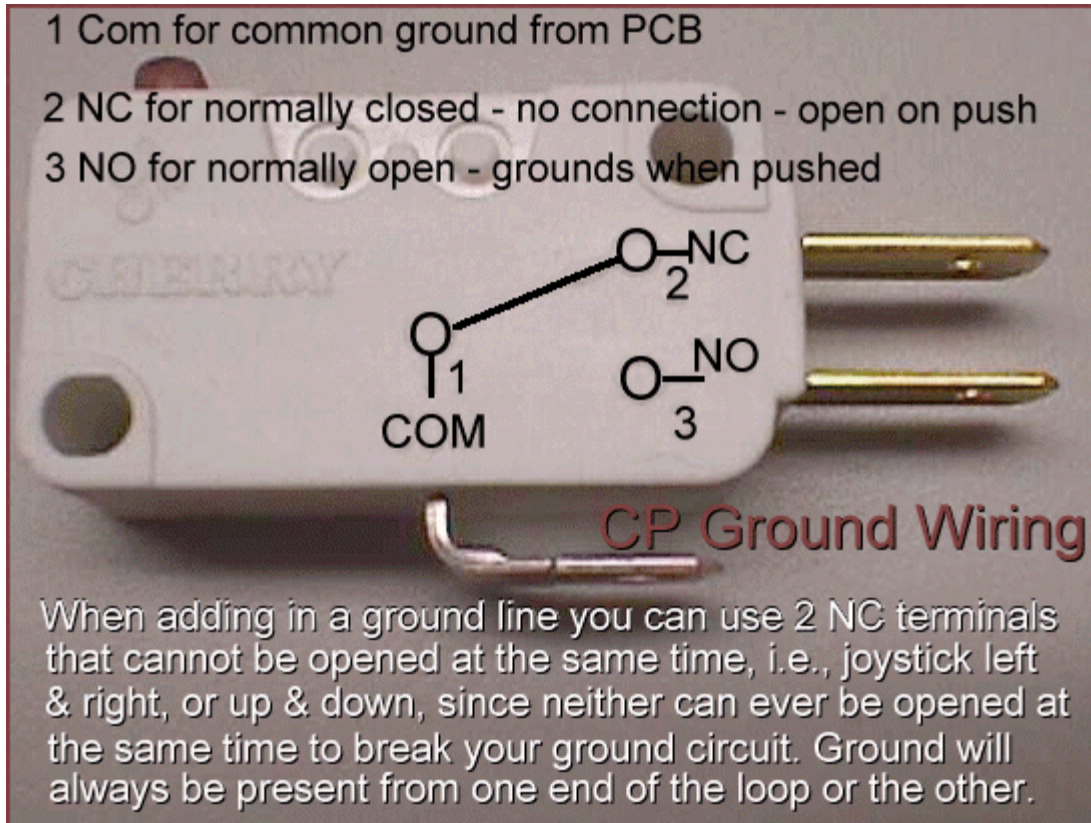
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- Cherry Switch -

1 Com for common ground from PCB

2 NC for normally closed - no connection - open on push

3 NO for normally open - grounds when pushed



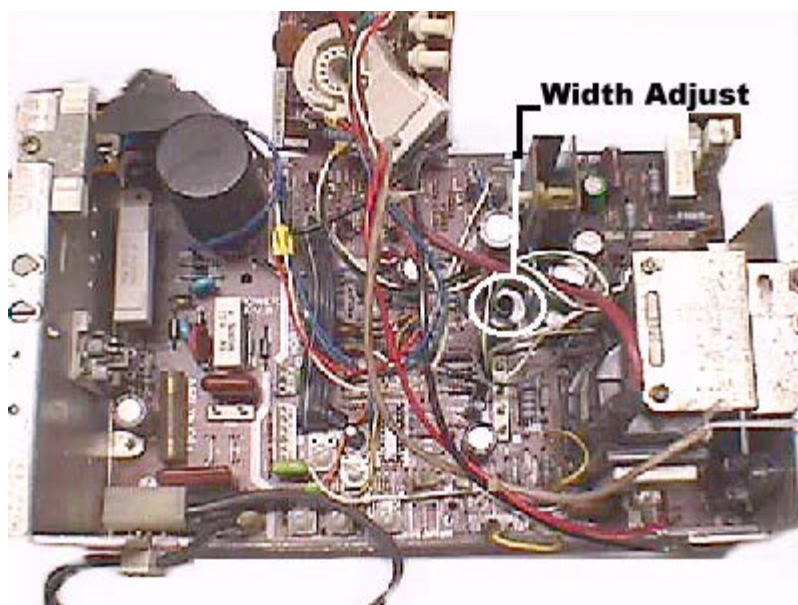
When adding in a ground line you can use 2 NC terminals that cannot be opened at the same time, i.e., joystick left & right, or up & down, since neither can ever be opened at the same time to break your ground circuit. Ground will always be present from one end of the loop or the other.

To view plug in cards click pic



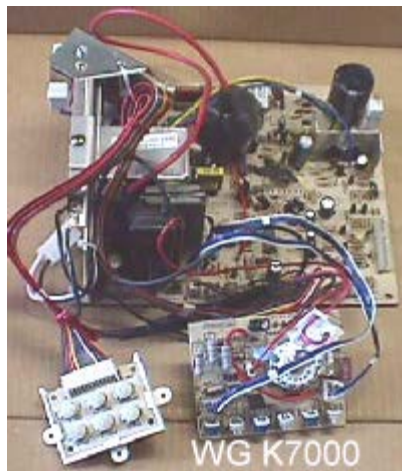
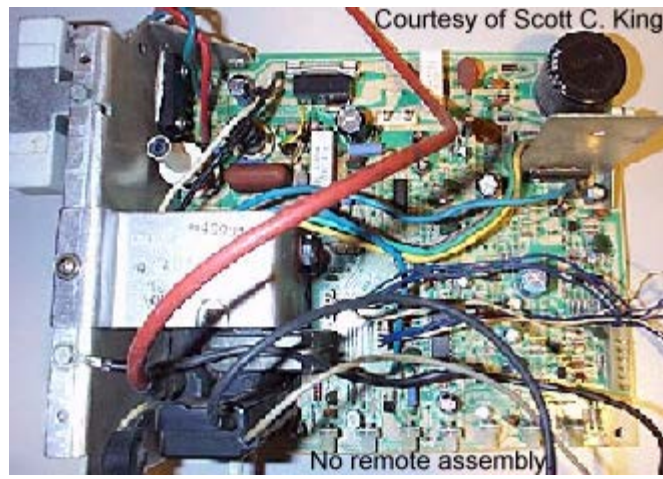
[Cap Map](#)

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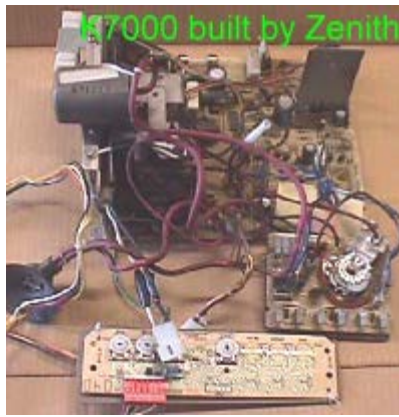
[Cap Map](#)

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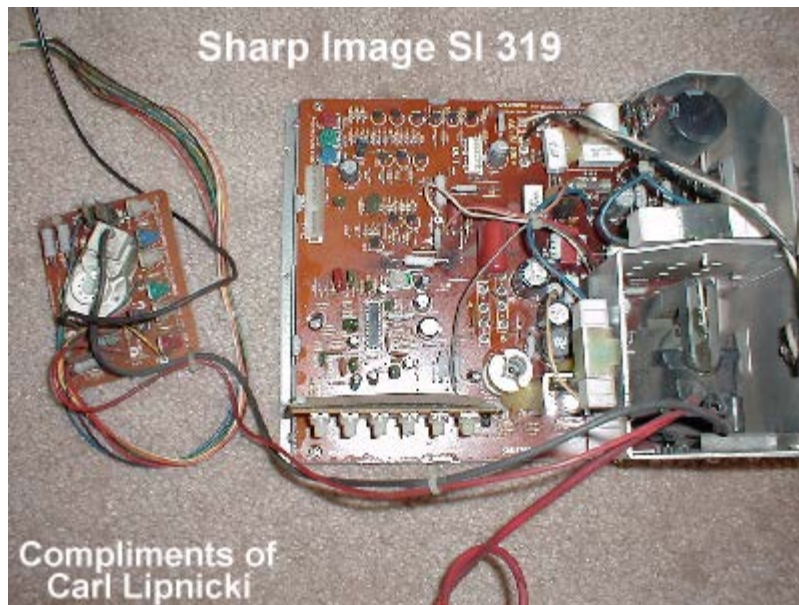
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This is the Electrohome GO5801 original monochrome X-Y monitor(QUADRASCAN), and the way to distinguish it quickly from the GO5-802 is by the regulator PCB mounted in the center with the 2 capacitors standing tall in the center. The GO5-802/805 both eliminated this regulator PCB. There are other differences, but this tells the you the whole story in a glance.

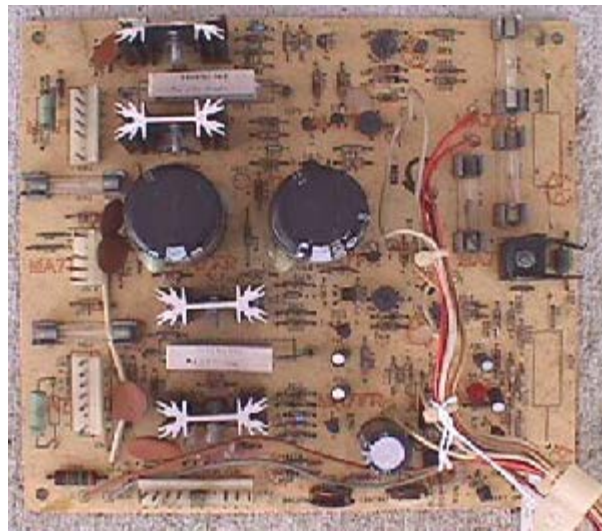
2009 Update: So many of you asked for new fresh CGA capacitors for the regulator bd that I had a batch made & they are finally here now. The new fresh pair sell for \$20 plus shipping.

Update 3/3/2012: Back in stock... just received a new batch of these from the factory. Unfortunately, they have gone up by \$1 to \$11 each or \$22 per pair needed.

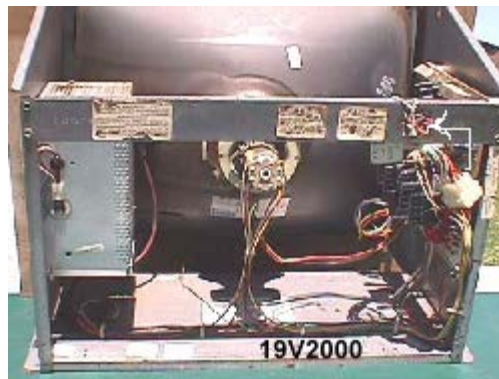
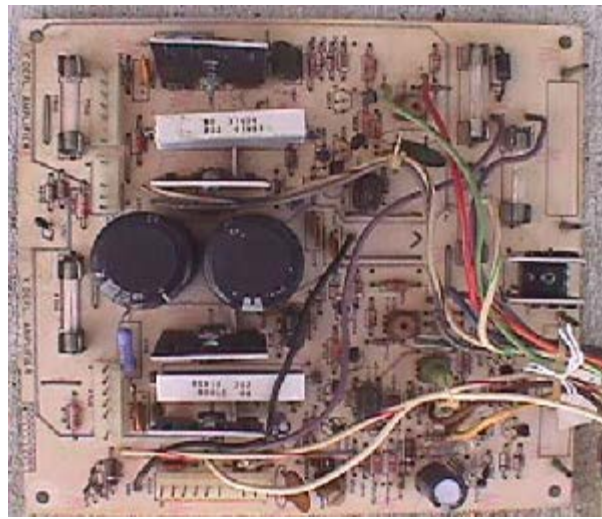
1x 7200uf50volt CG cap - \$11.00 or 2x 7200uf50volt CG caps - \$22.00



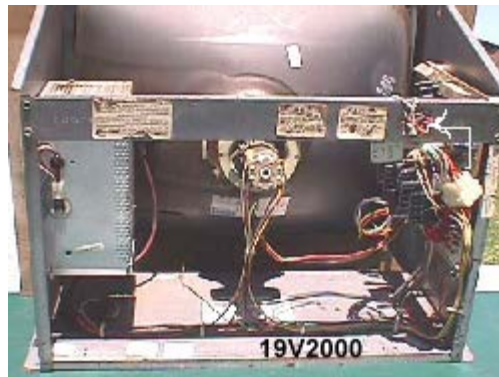
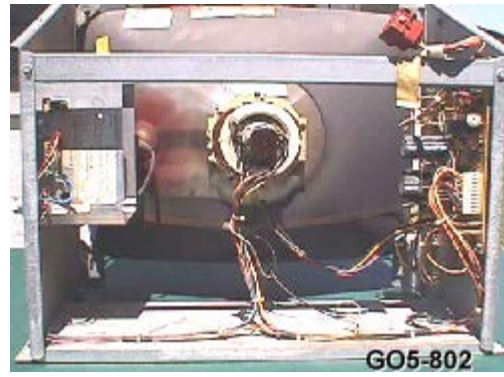
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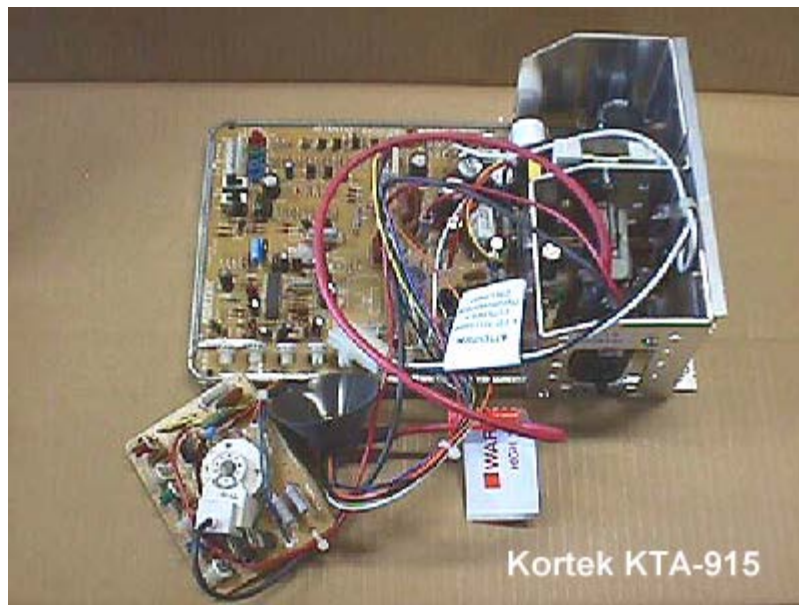
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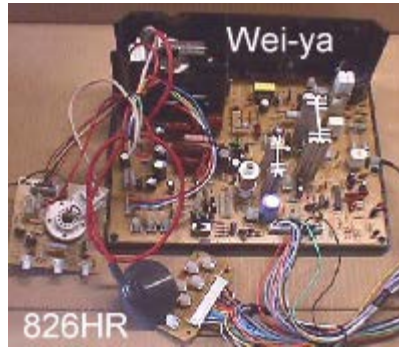
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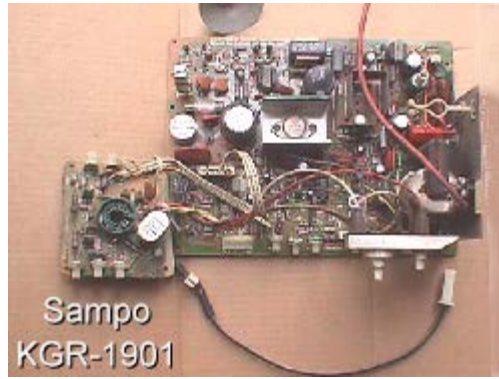
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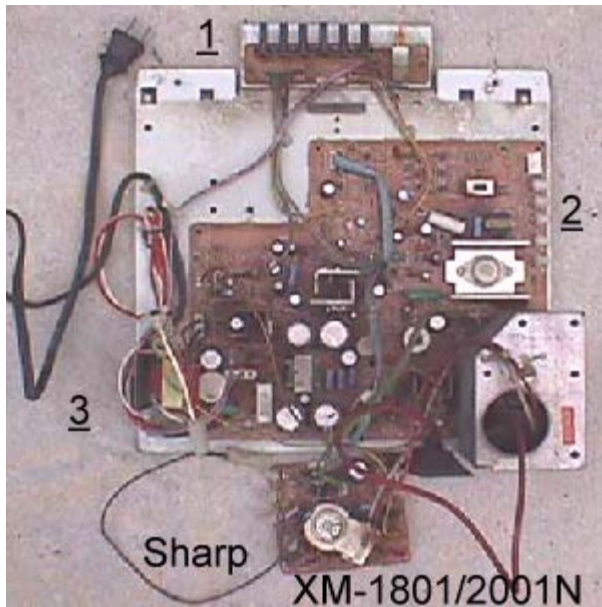
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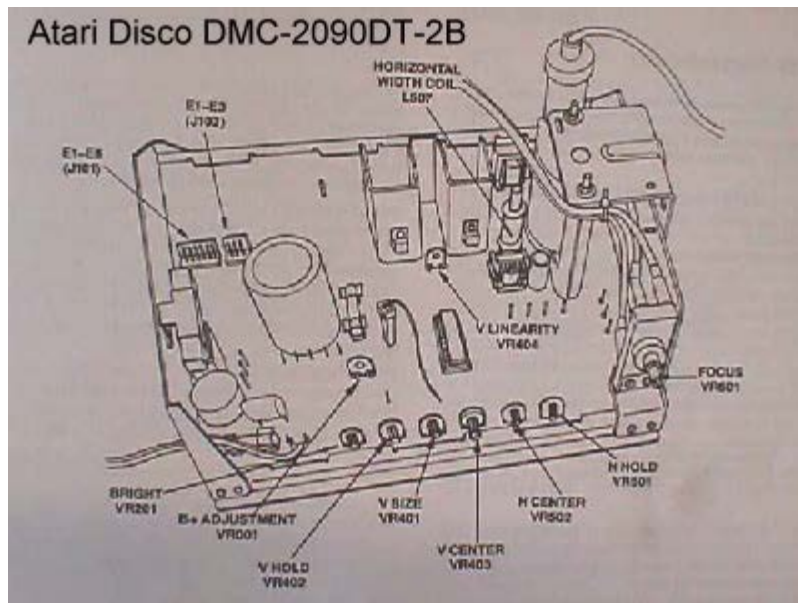
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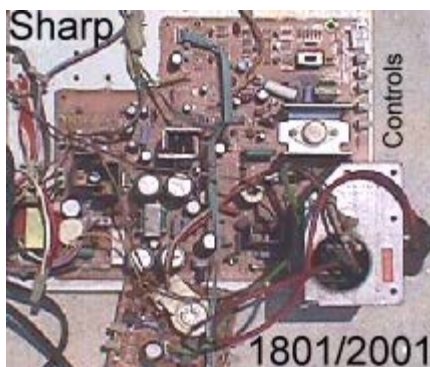
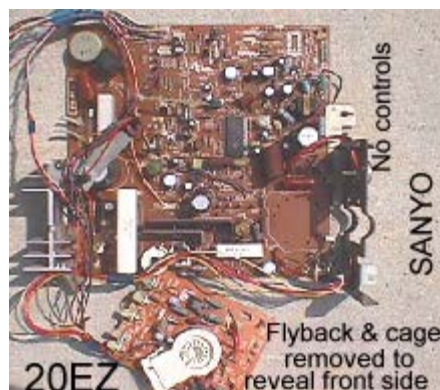
The XM-2001N has the control board 1 in position 3 & is adjustable from the back of the chassis. Many people confuse the Nintendo type Sanyo 20EZ with the Nintendo type Sharp XM-2001N. The easiest way to distinguish at a glance is by the controls located at 2 which are label RGB gains/sub-bright/V-lin on the XM-2001N & are not found on the Sanyo 20EZ. There are other obvious differences as well, but this one will give you an ID in a hurry.

Check "Nintendo Difference" to compare both chassis'.

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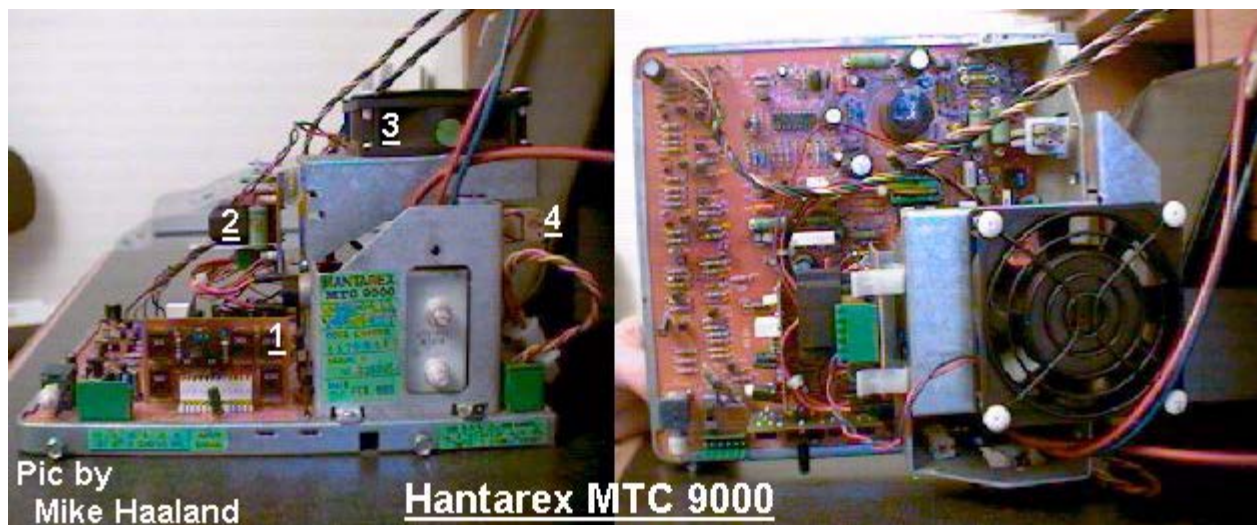
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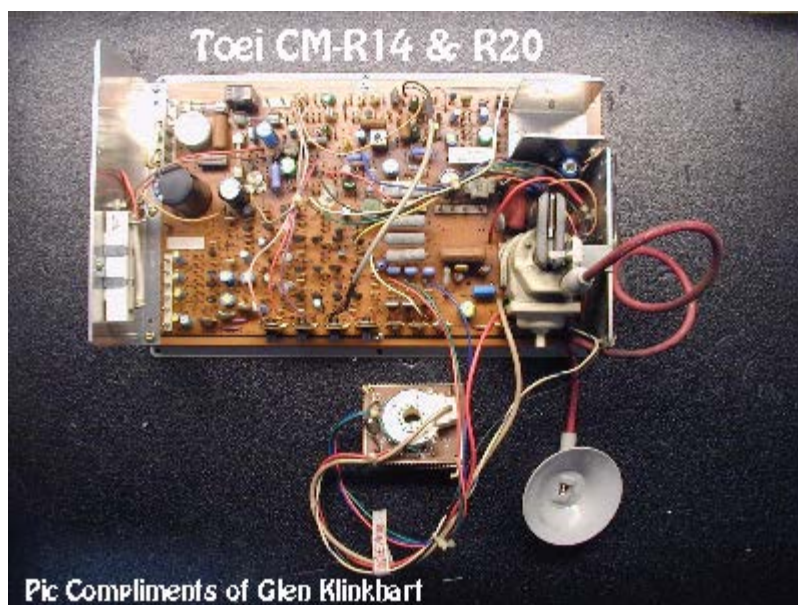
[Cap Map](#)

1. Control board can be located remotely via a ribbon cable extension.
2. East-west tracking optional pcb attached to fan bracket.
3. Optional fan/bracket used on some versions attaches to flyback cage.
4. If this long resistor..330 ohm 30w..is hot enough to burn you, you need a new flyback.

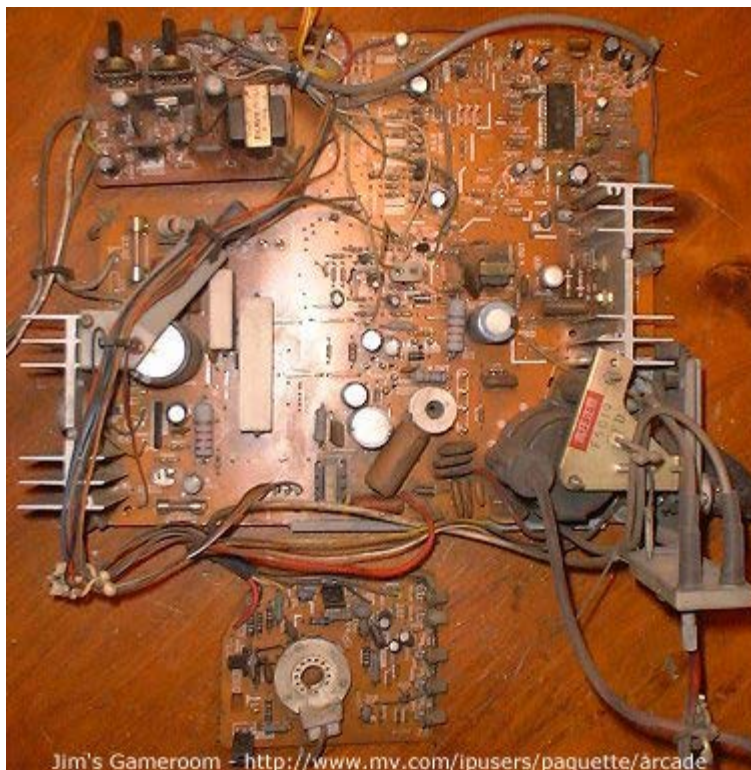
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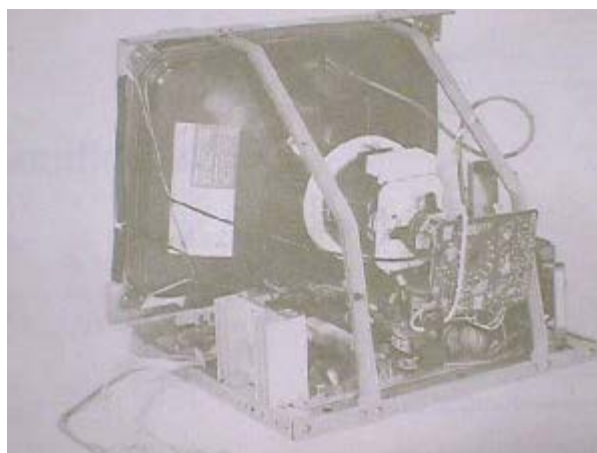


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~~~Thanks Jim. This pic should help out a lot. ~~~

Sanyo 14" Color Monitor



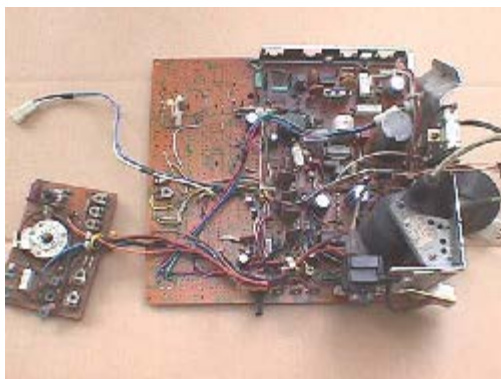
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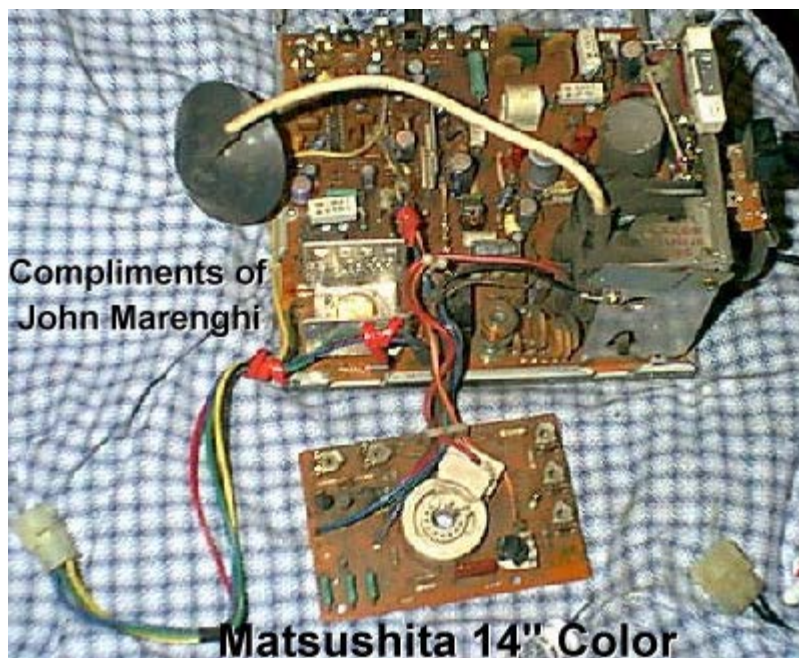
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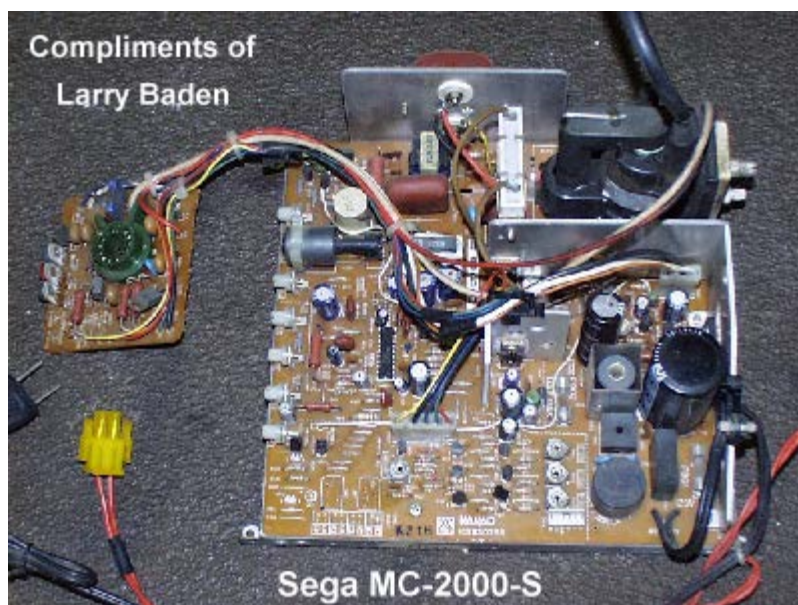
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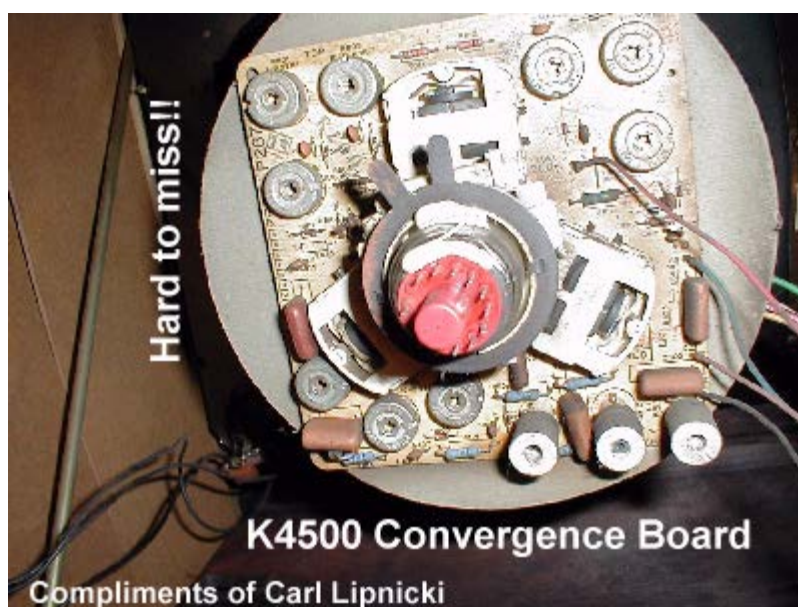
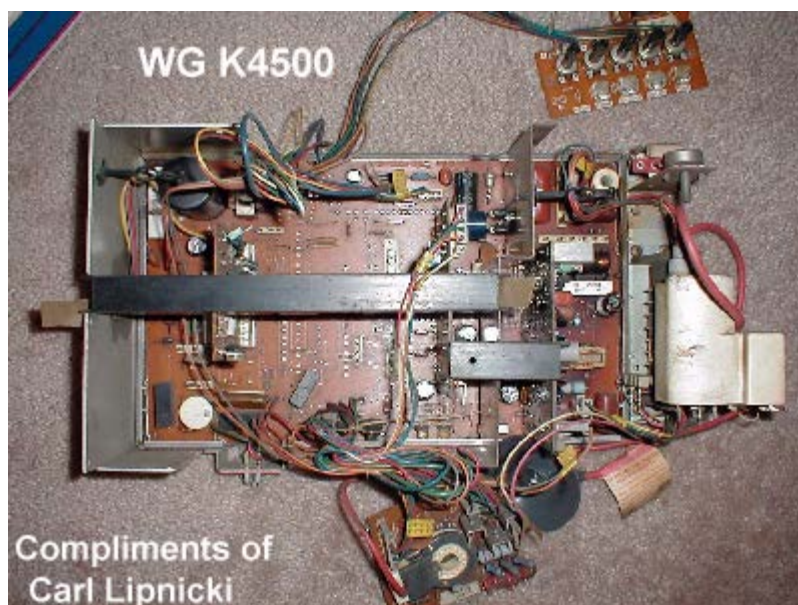


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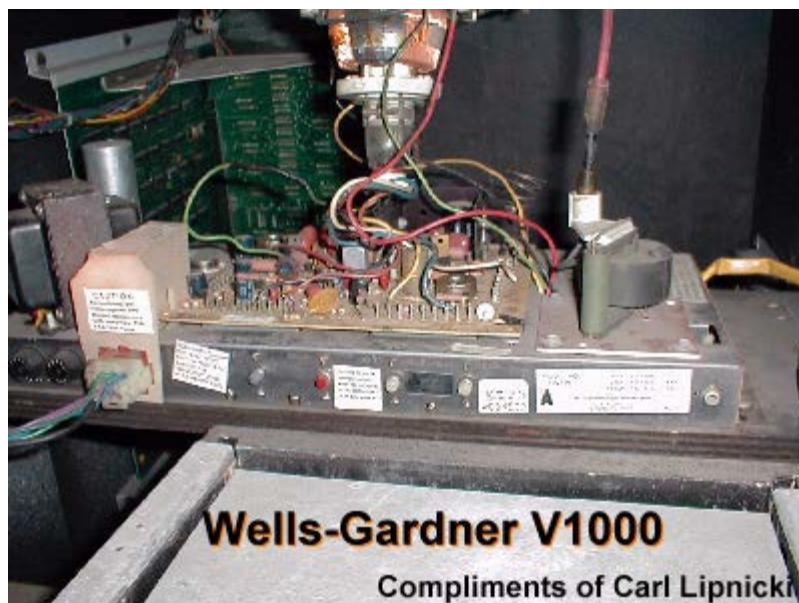


[Cap Map](#)

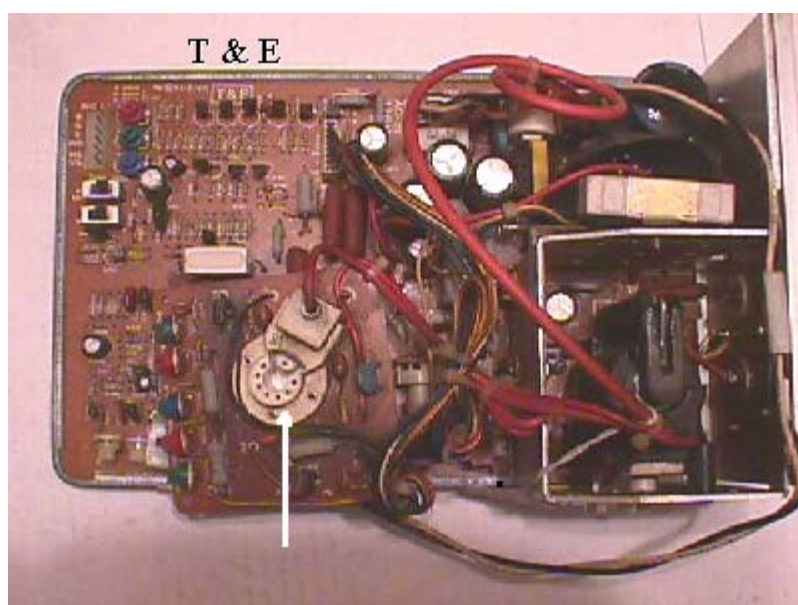
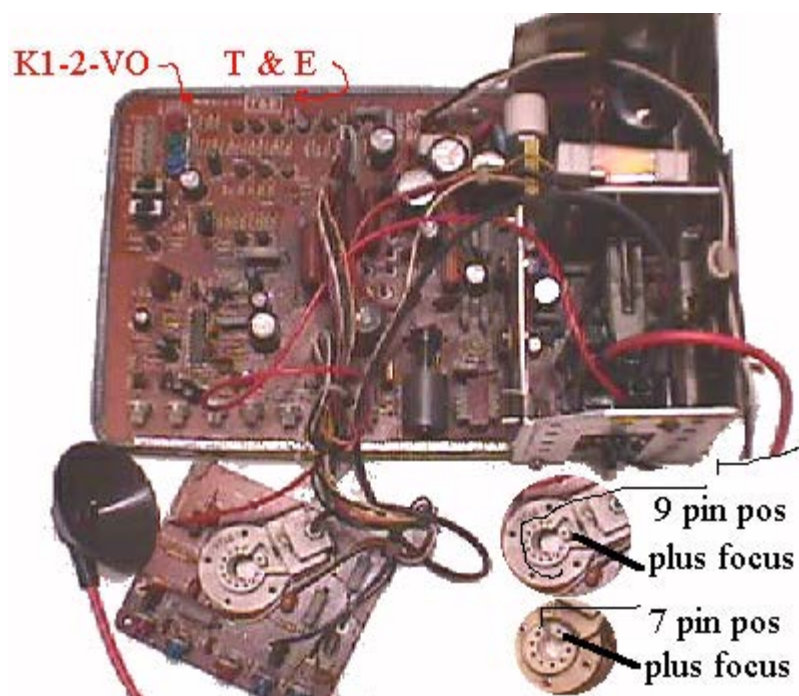
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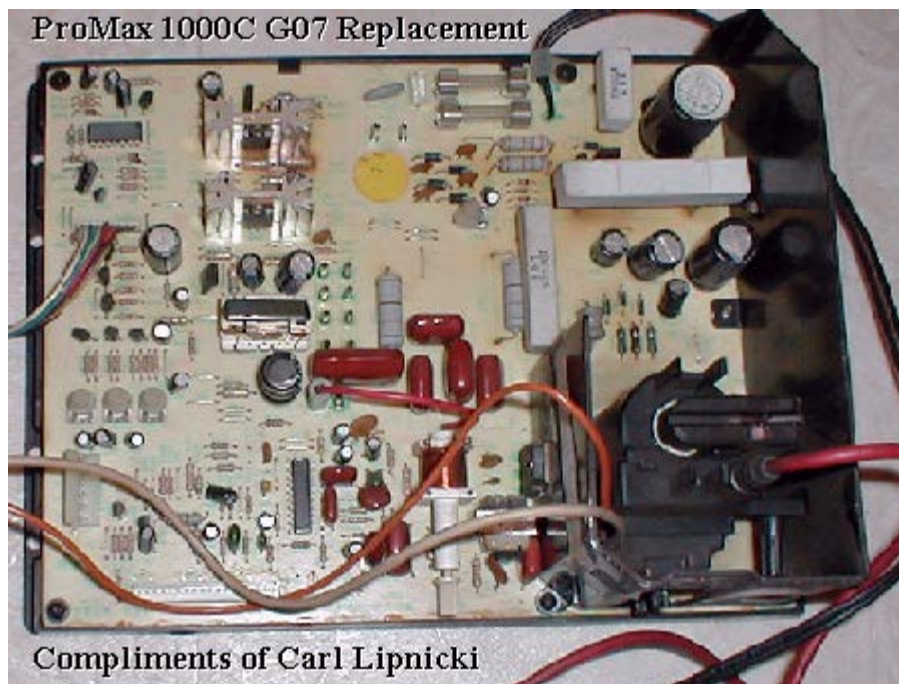
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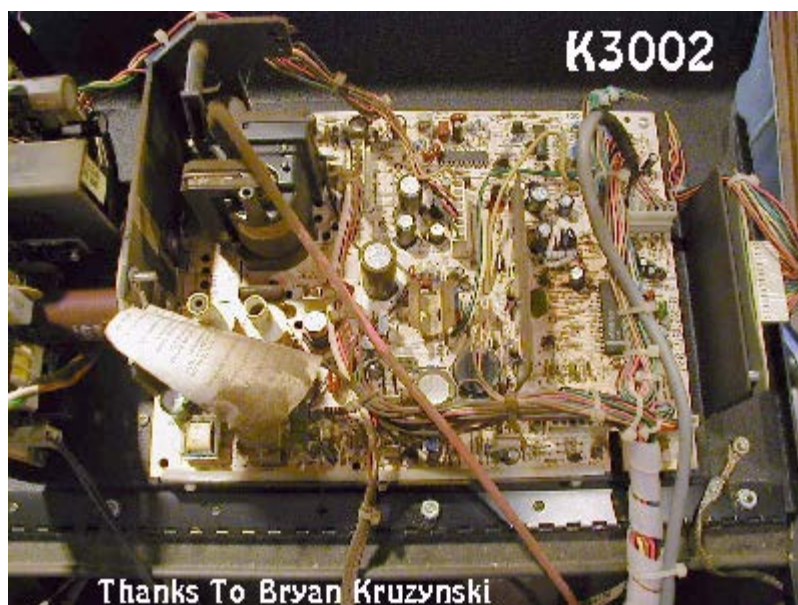
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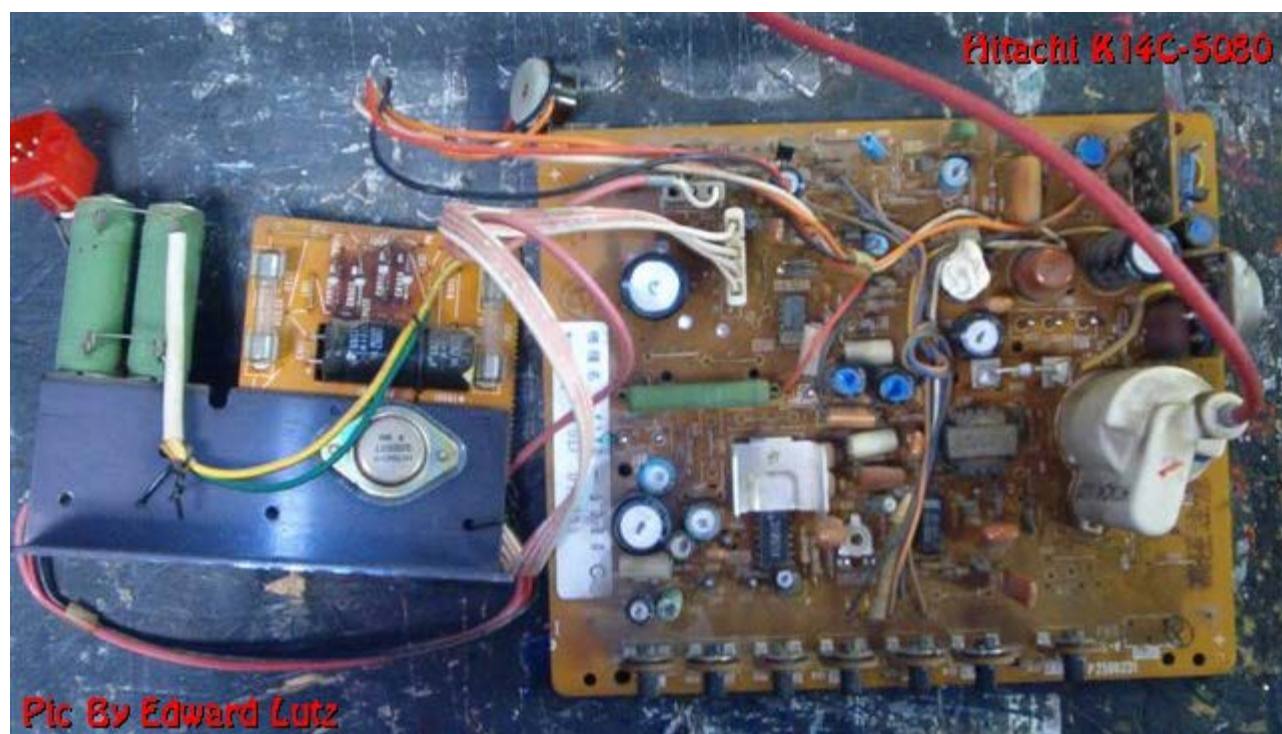


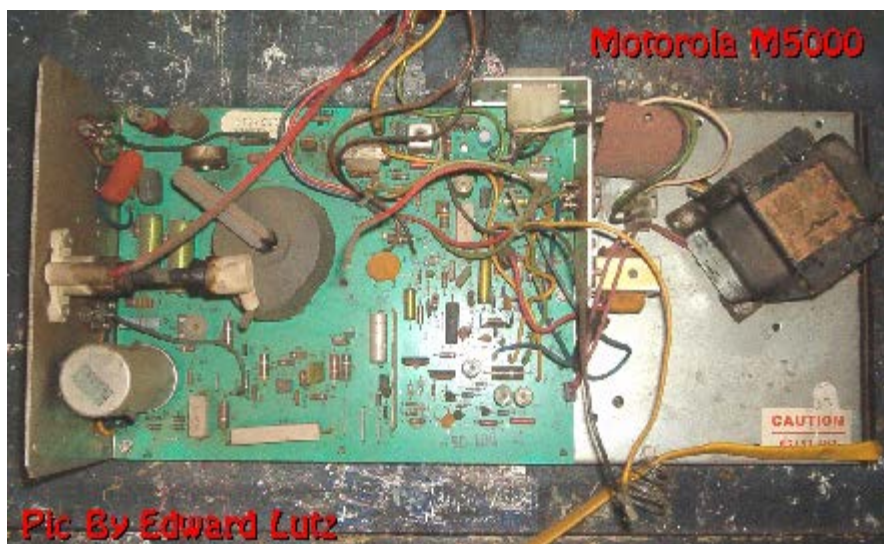
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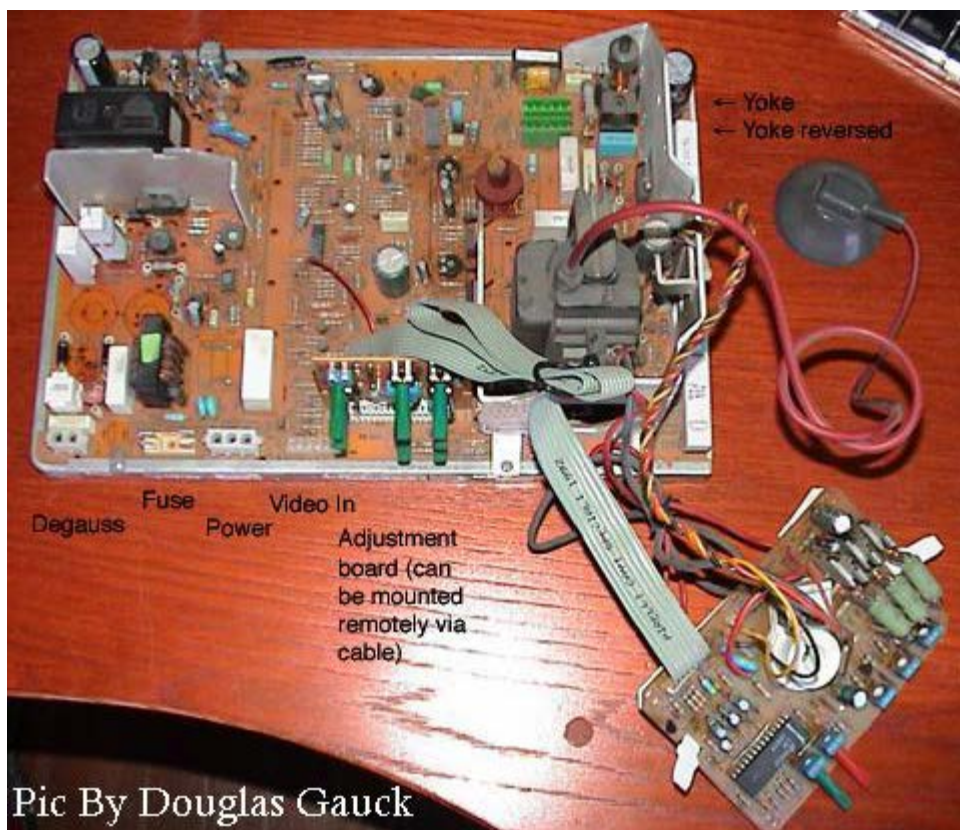
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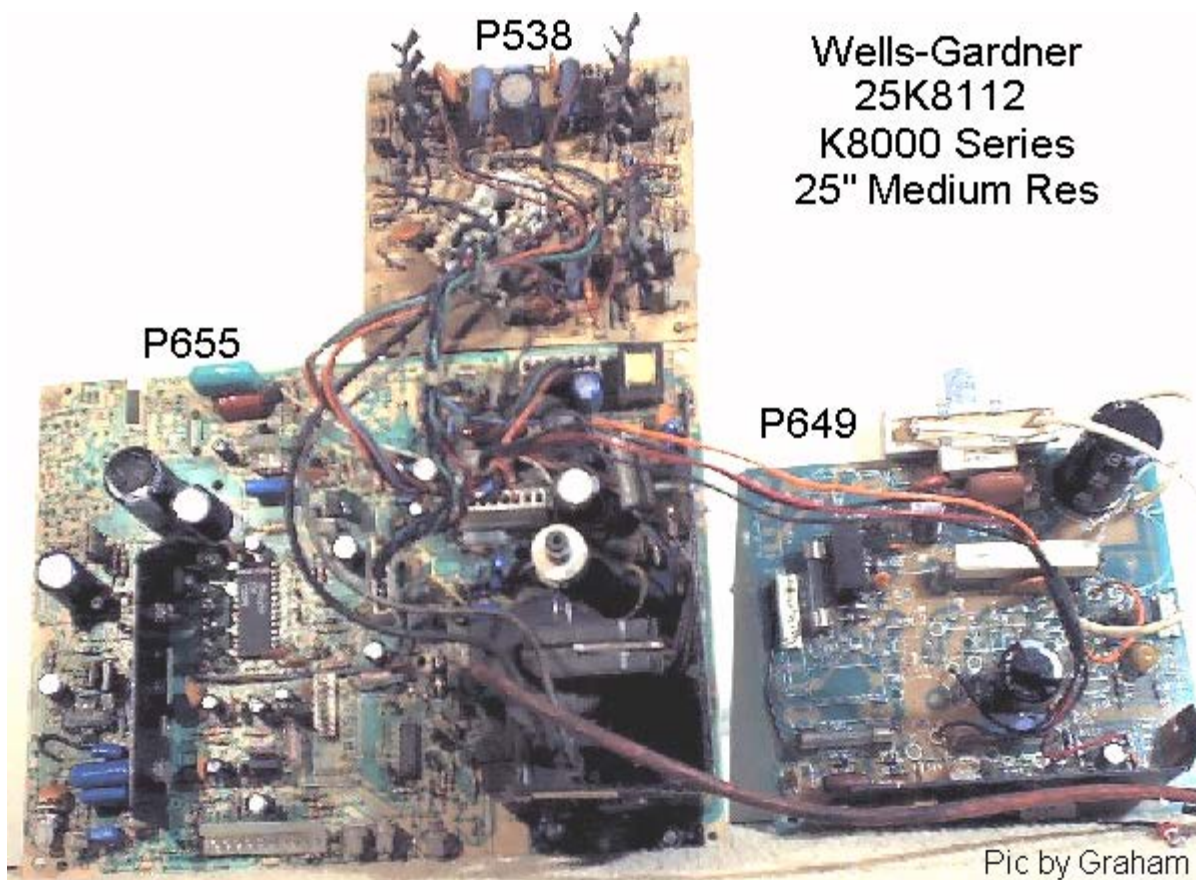








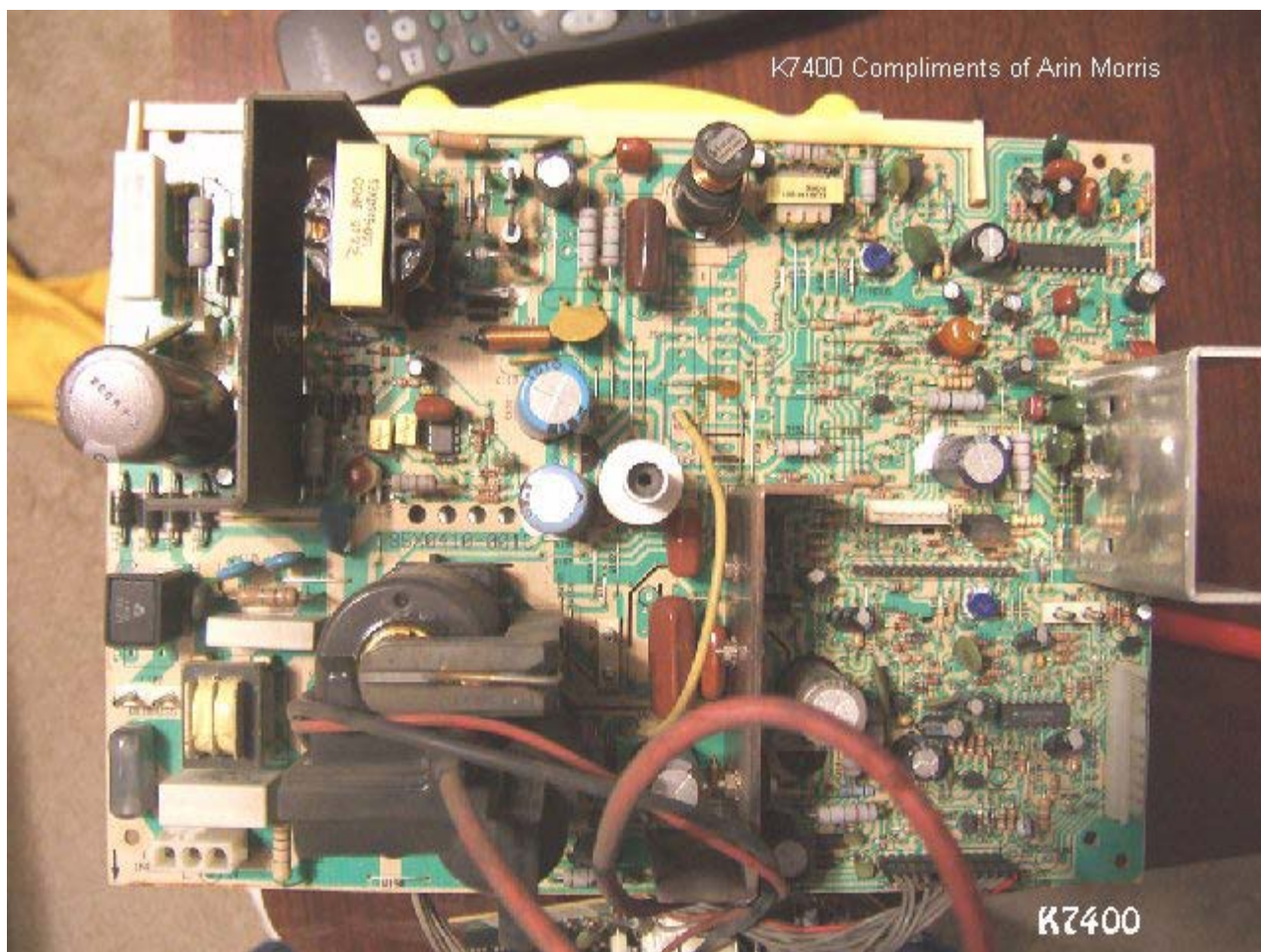


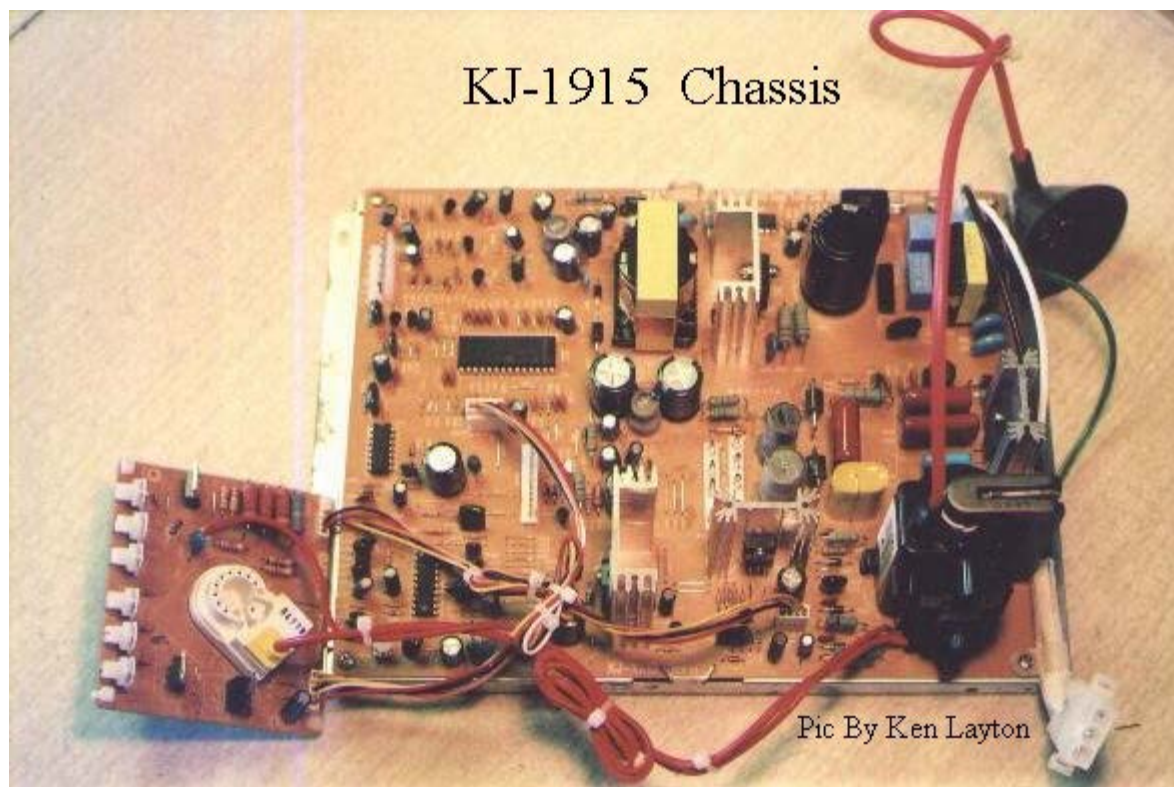




Early Pentranic Chassis (Eygo)

*Pic Compliments Of
Hans Eilers*





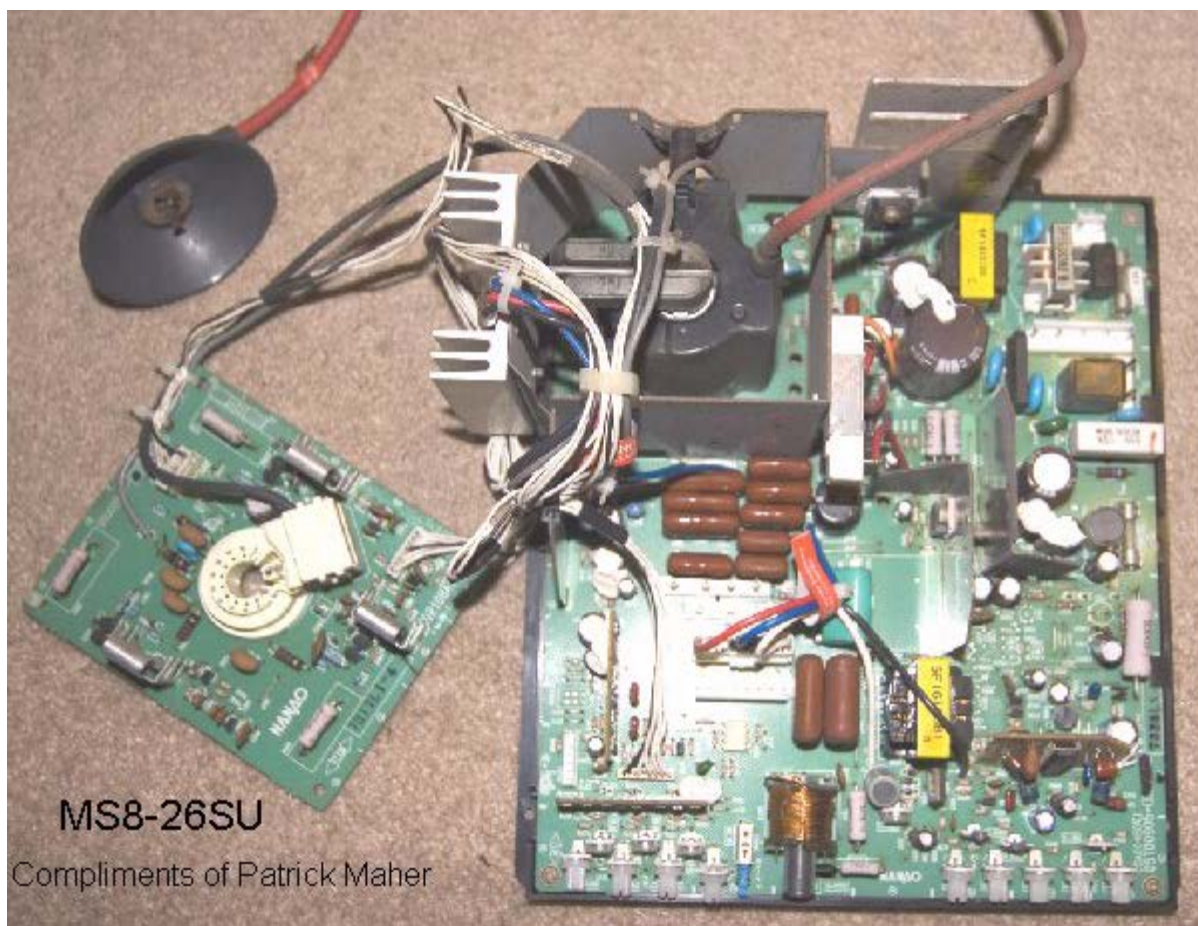


Kortek KT-2502LF



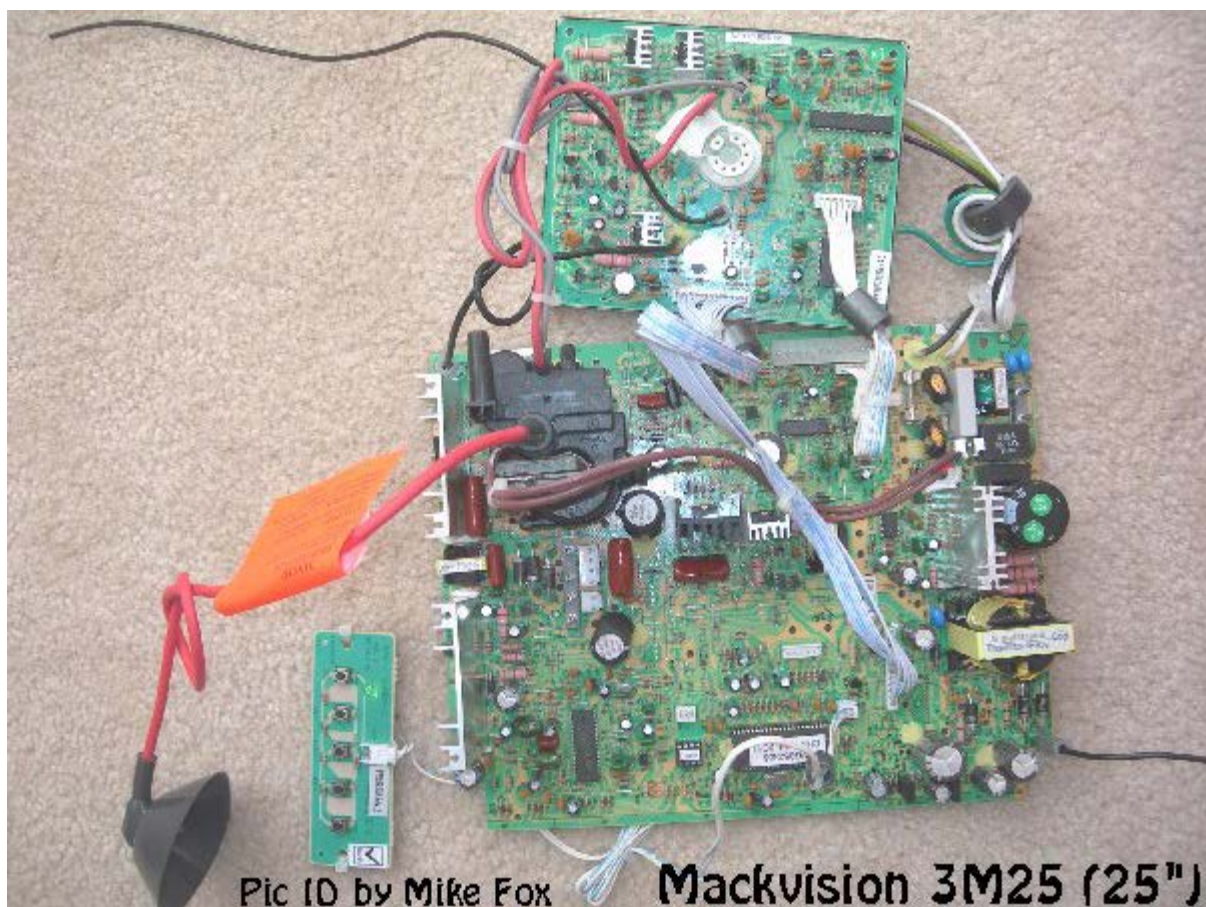
Thanks To Photog Jeff Para





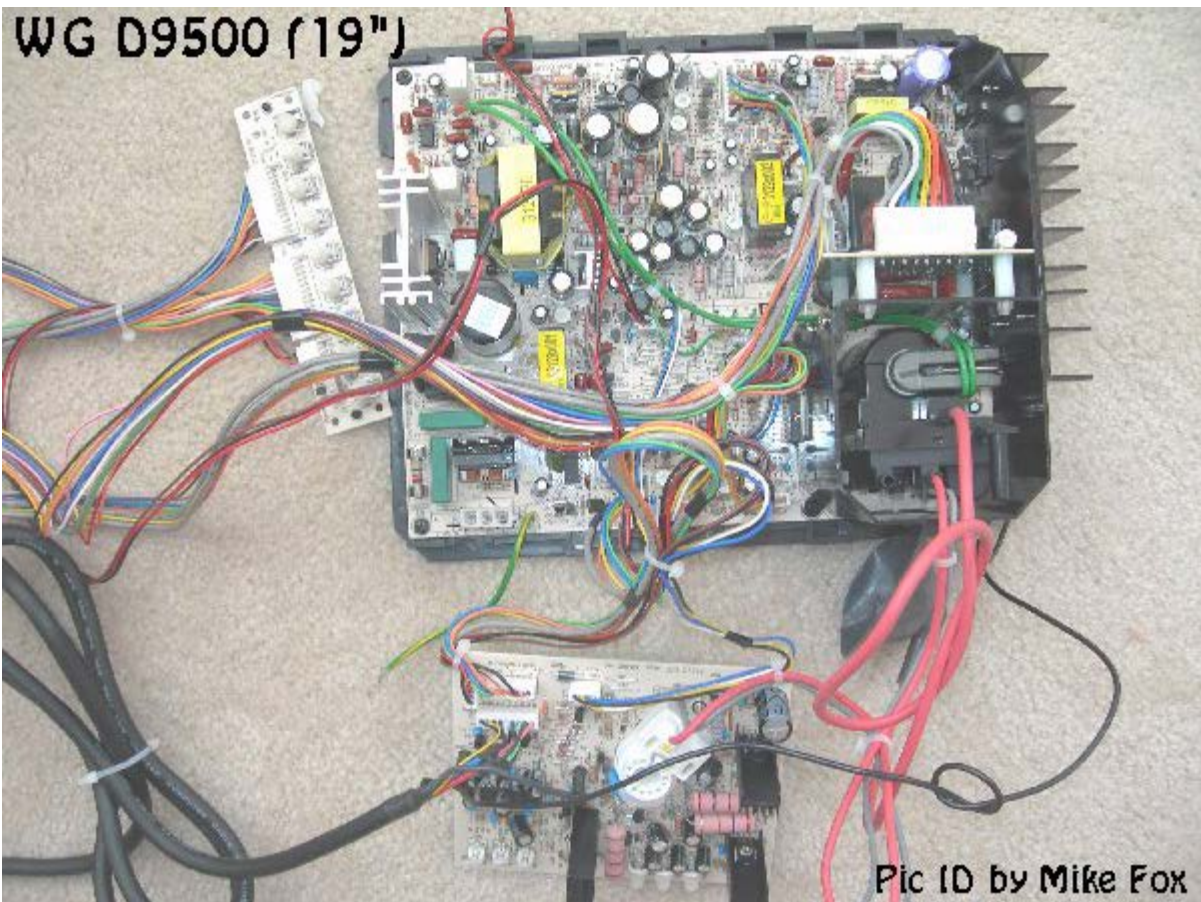
MS8-26SU

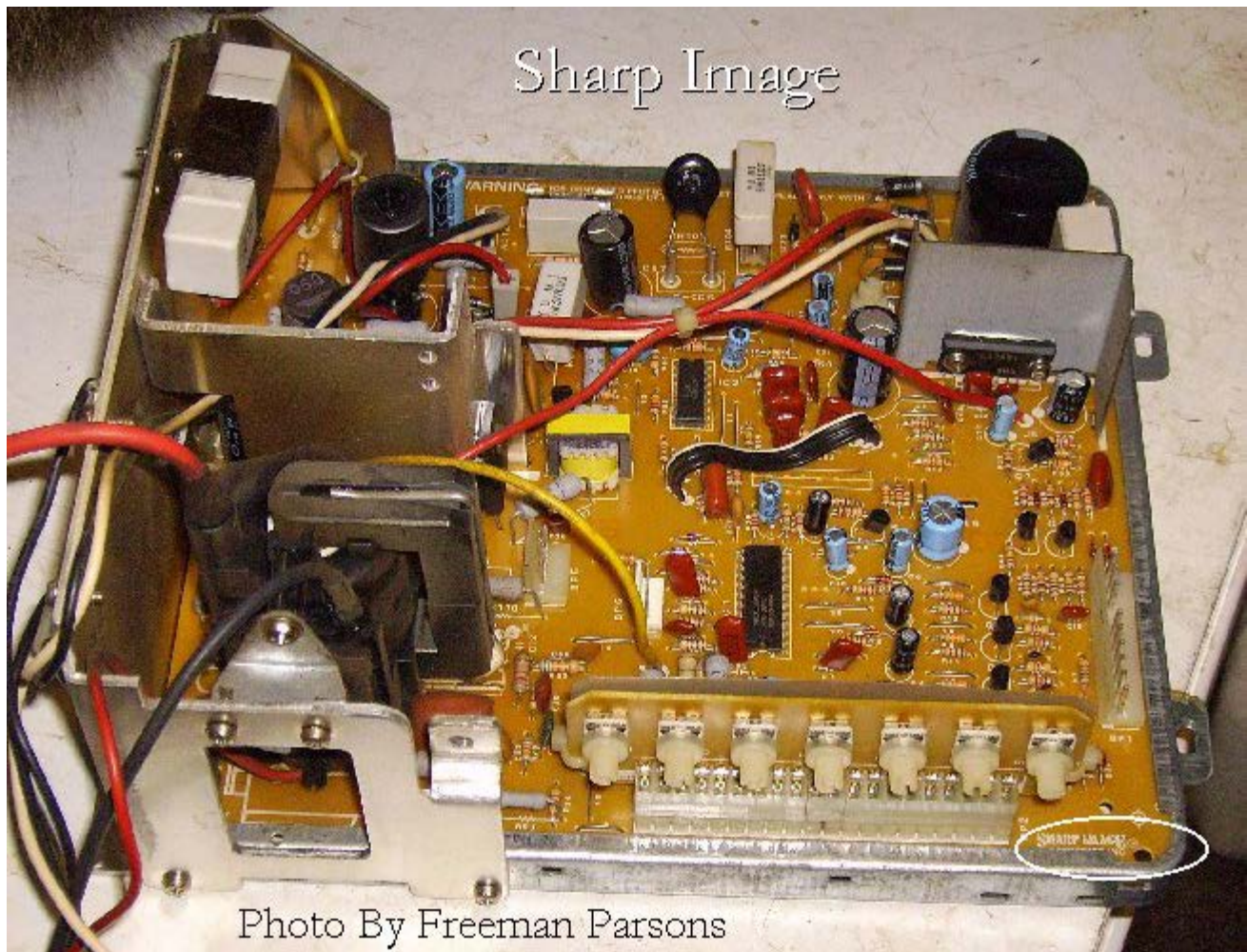
Compliments of Patrick Maher



Pic ID by Mike Fox

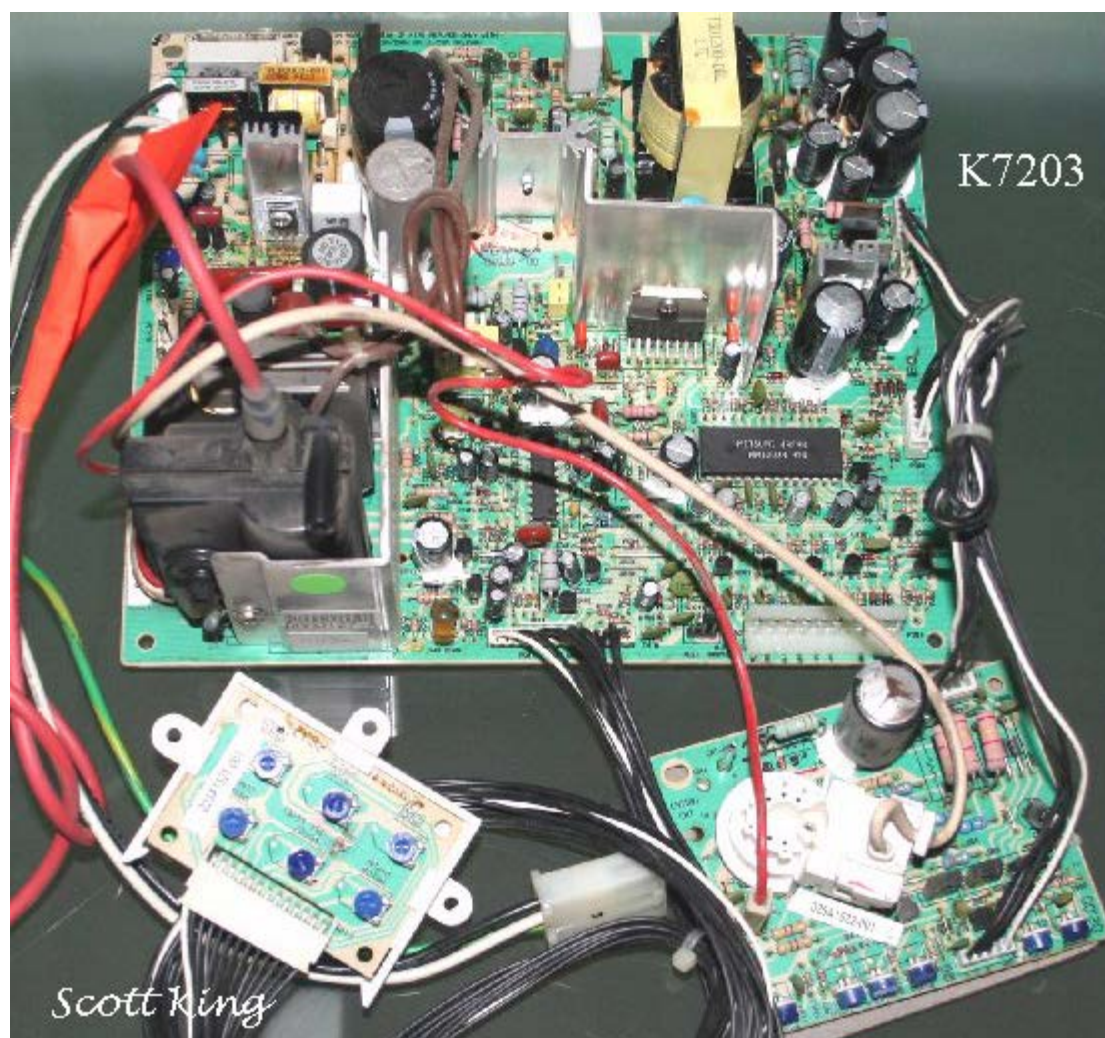
Mackvision 3M25 (25")





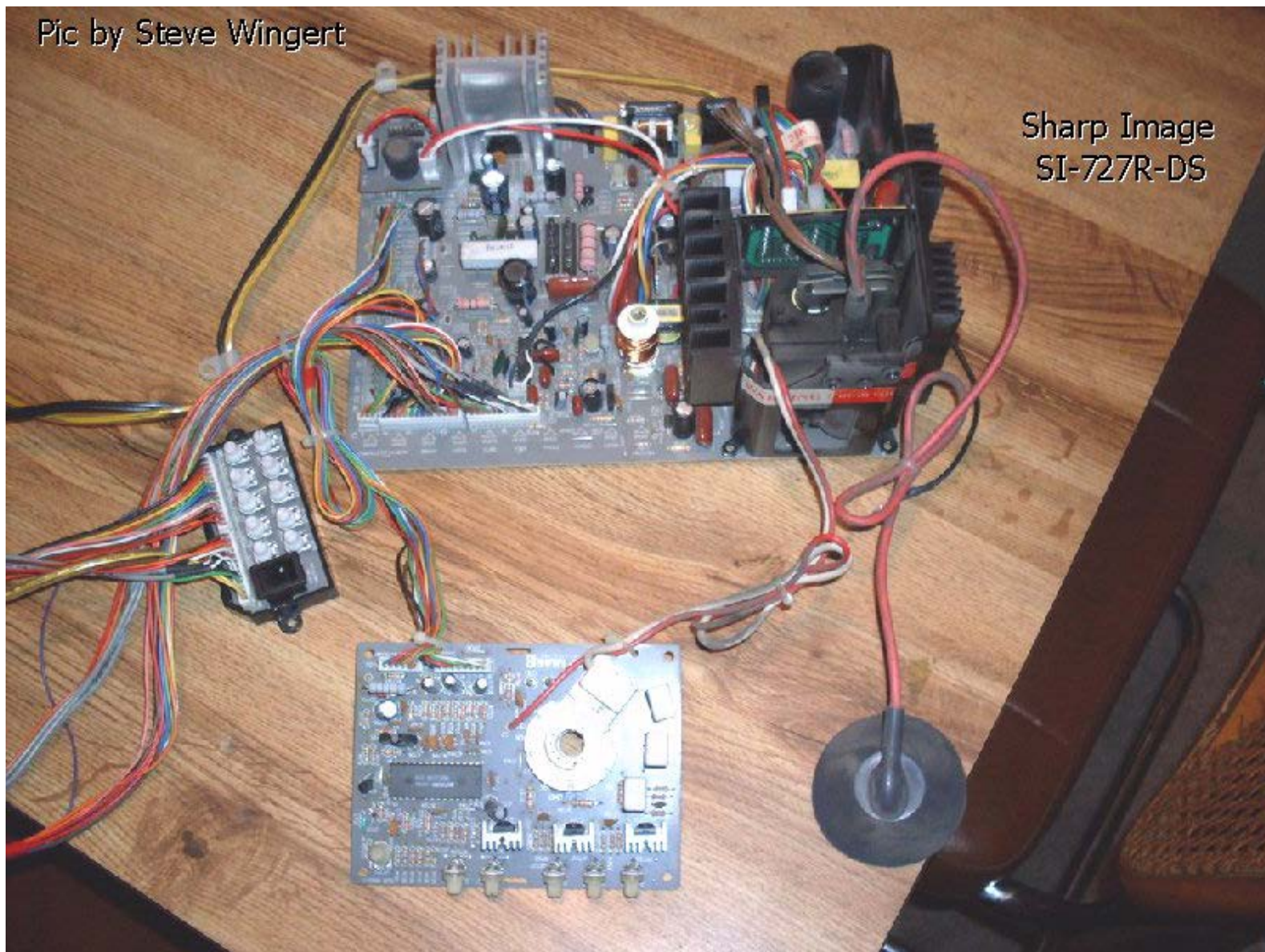
Here's a chassis that came out around the time that I began my retirement that I had never seen... at least until August of 2007. It has no readily visible chassis model number, so I was trying to match it up to one of the known SI models for a cap kit without any success. It just did not fit the SI family at all.... cap values or positions. Freeman posted pics on his site & as I looked it over it seemed very familiar to me, yet somehow different enough to keep me from an instant guess, that is, until I zoomed in on the ICs.... CLICK! They are the 7823 & 1397 which gave it away. Do you have a guess at what cap kit you should get to redo this one? When you give up you'll find the answer here. [Answer](#)

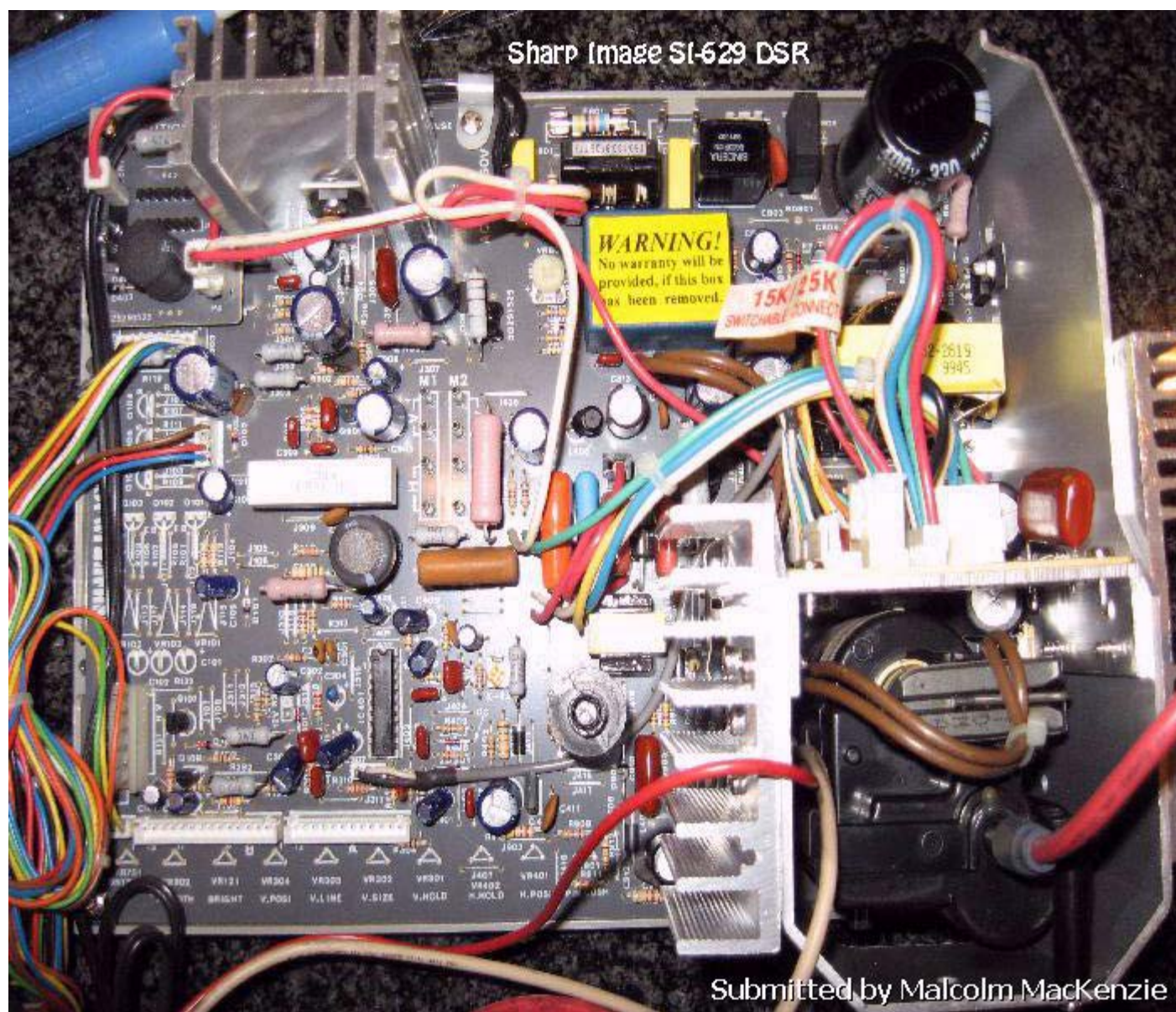
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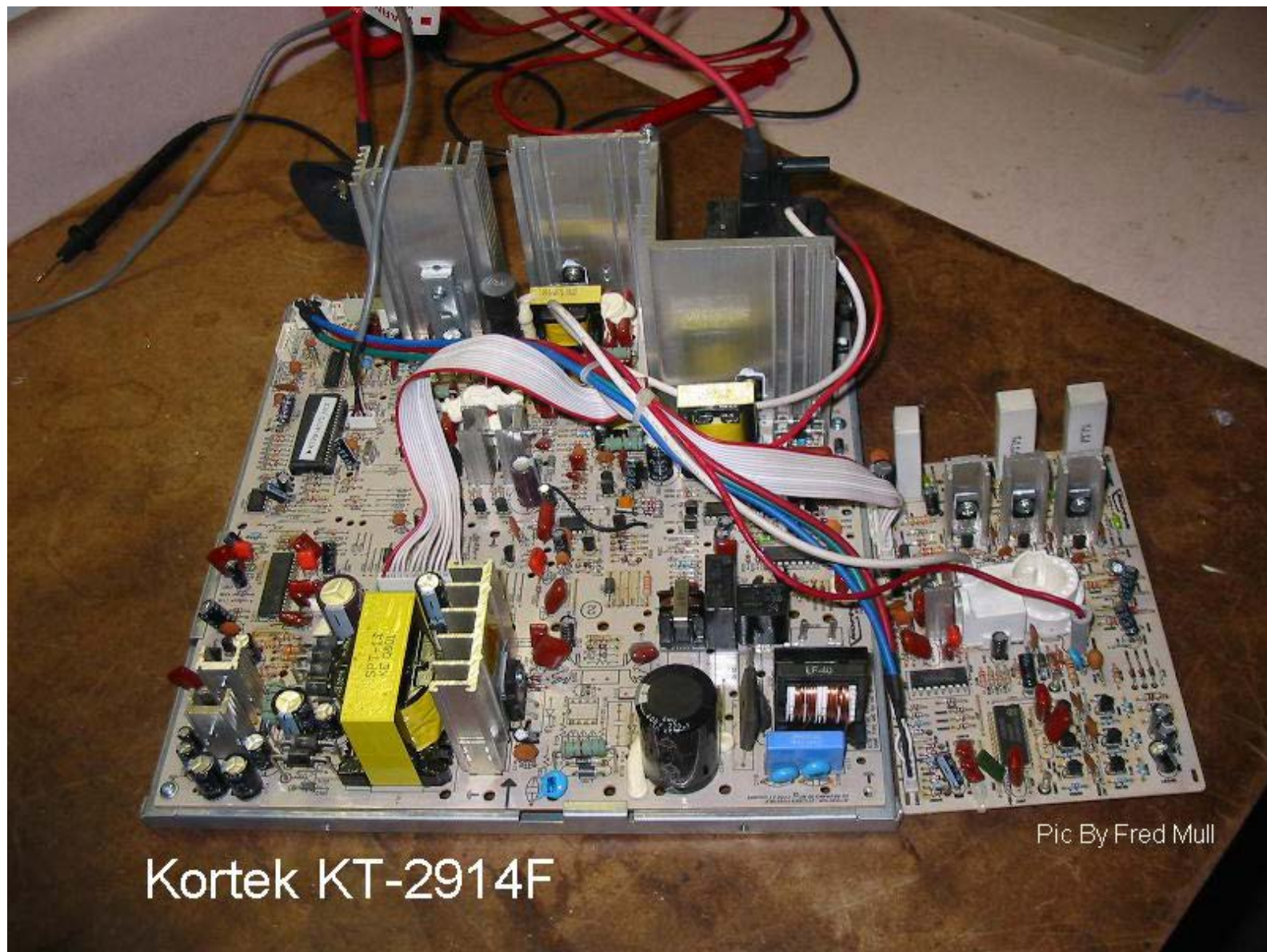
Pic by Steve Wingert

Sharp Image
SI-727R-DS



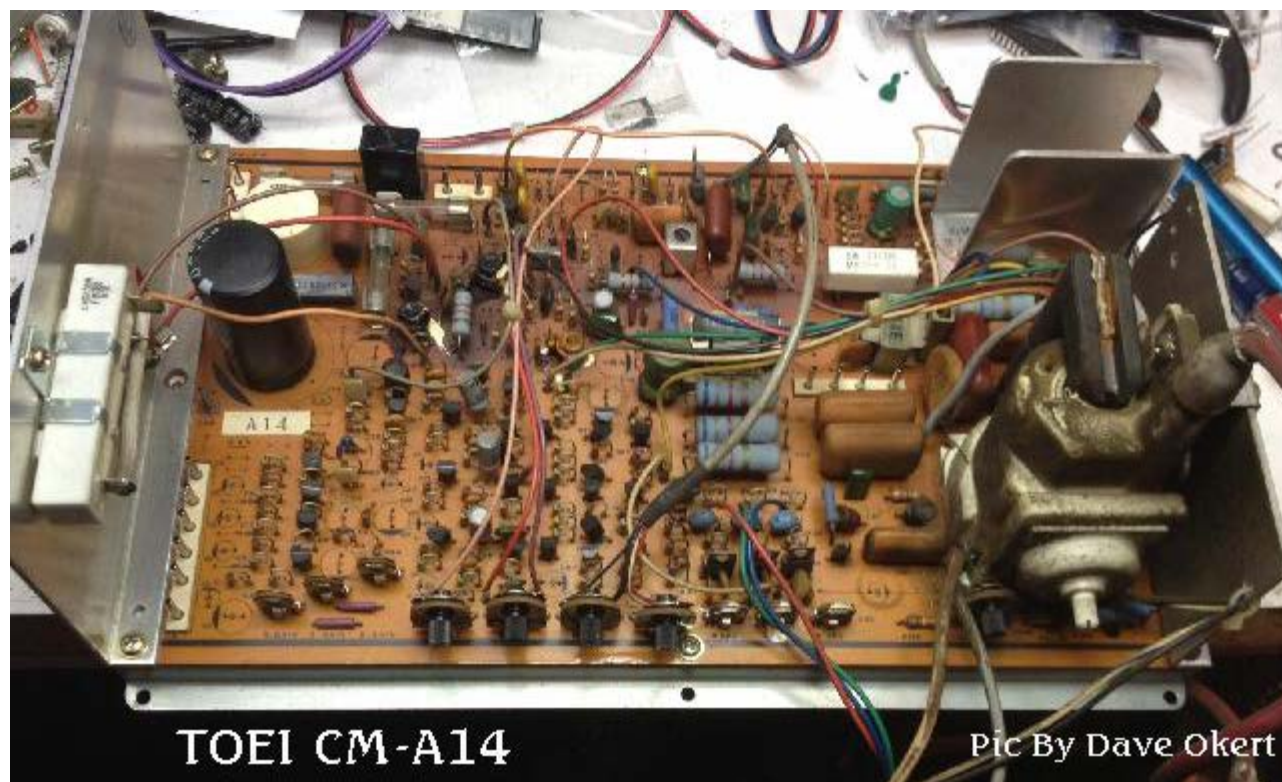






Korteck KT-2914F

Pic By Fred Mull

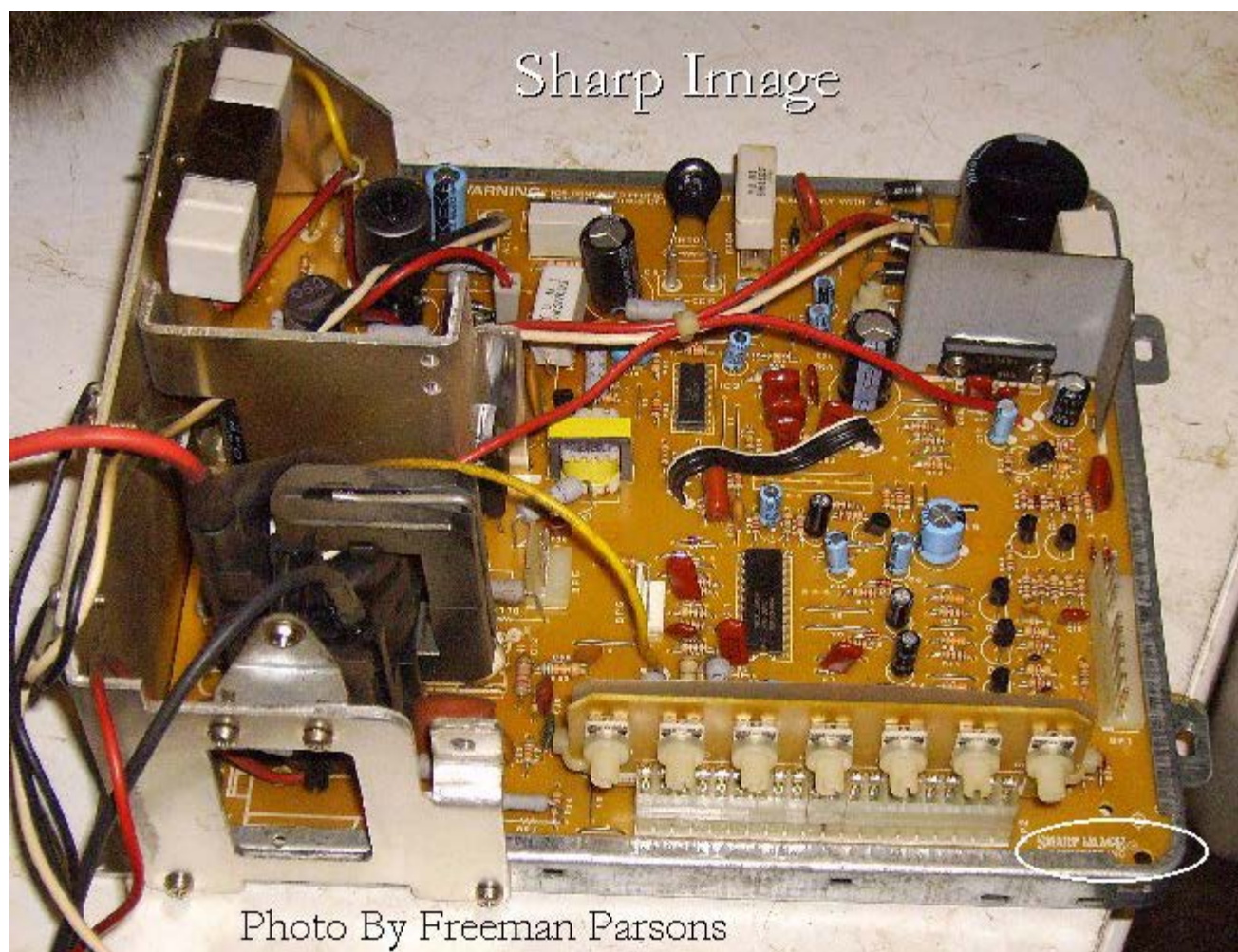


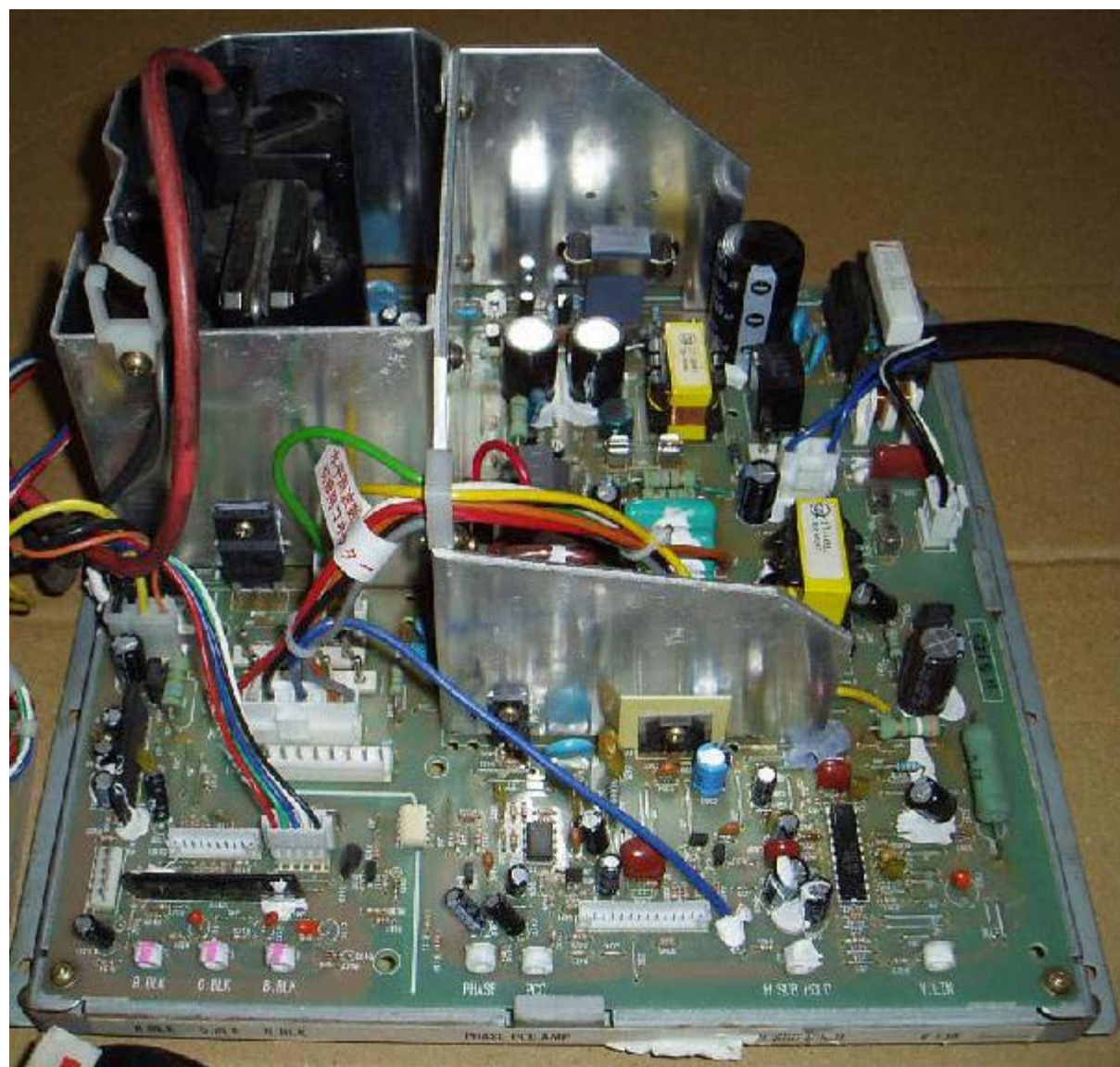
Kortec KTX-26
SI-327 STD RES
Imperial 44-4050



Pic by Michael Woodrow



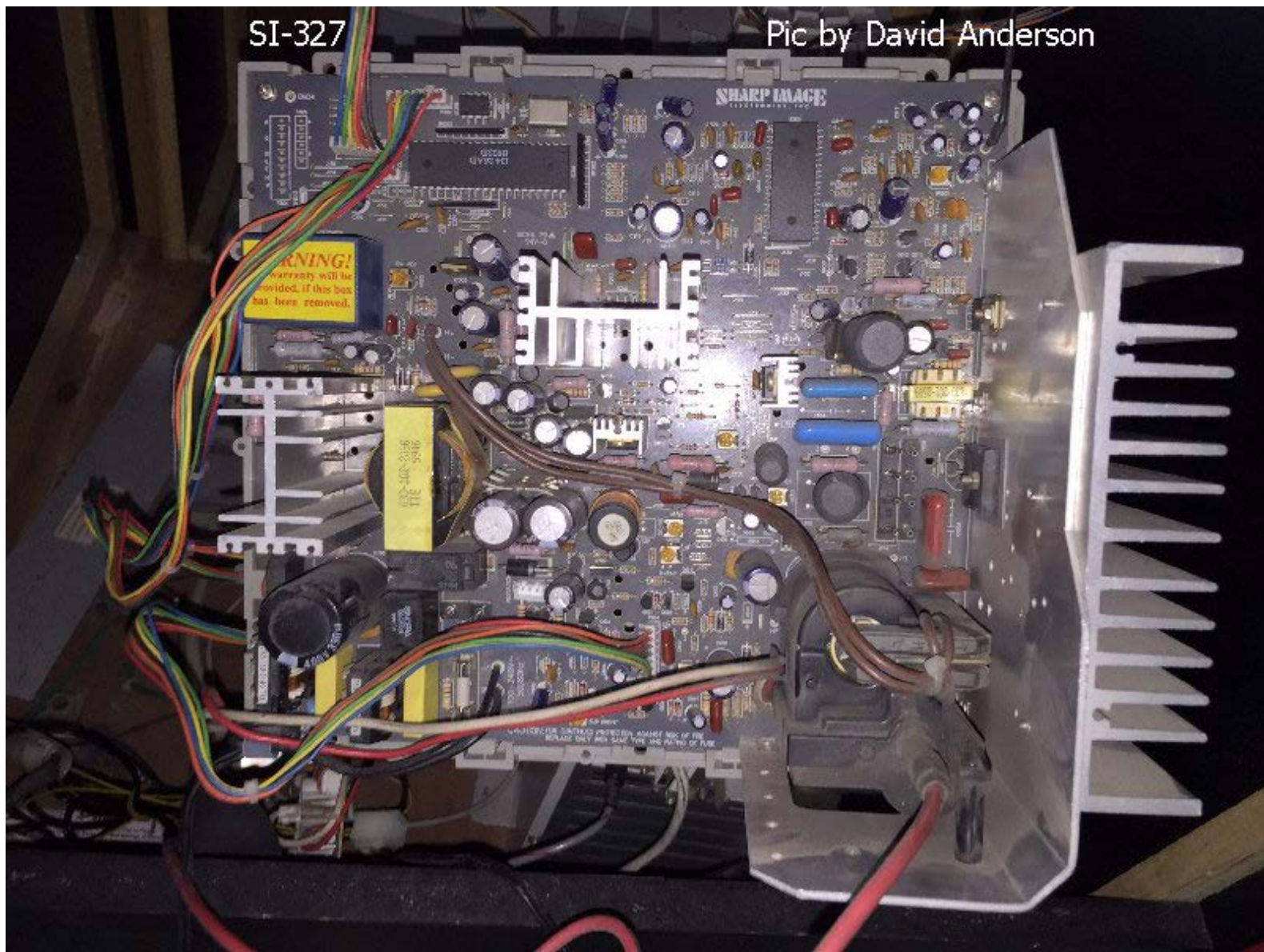






SI-327

Pic by David Anderson



Wiring Your Pac Cabinet

by Bob Roberts

Chapter 3 - DC Wiring

Well... the last time I worked on this project it was a beautiful day... no such luck today, though :-() It's a raging Louisiana summer thunderstorm outside... cannons sounding just outside my window while the heavy downpour tests my new roof, which, incidentally, must have been sprinkled with gold flakes to have cost so much :-() It's a good thing I snapped all my pics on the warm sunny day!

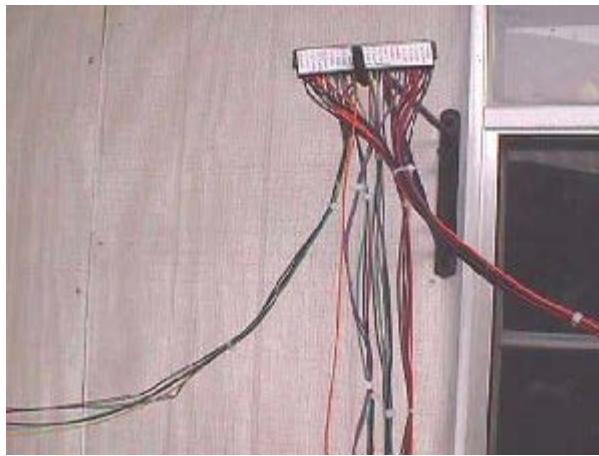
Forging ahead into the DC wiring now without further ramblings... we're off :-)



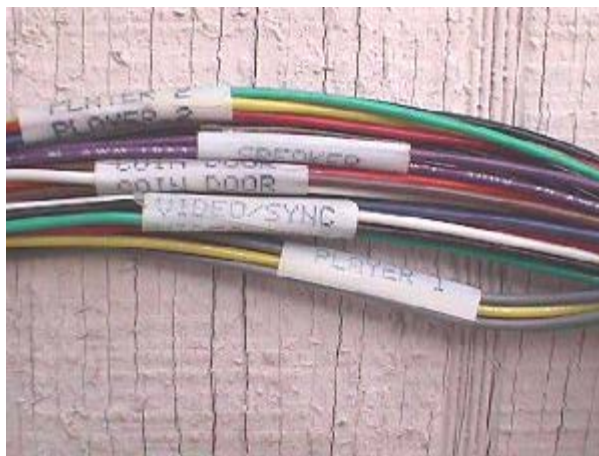
If you got the deluxe Pac harness kit as pic'd above you should have all you need to complete the wiring.



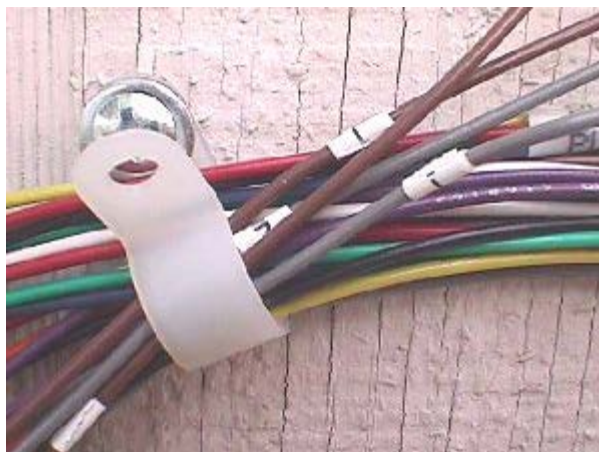
Did you ever have that feeling that someone was watching you build a Pac game on your lawn in the backyard? I did, so I looked around & sure enough, there was that little fellow that works for Geico Insurance taking it all in. Didn't realize he was a gamer :-)



Here's the harness straight from the package & hanging on Alice's plant pot hanger. All the bundles have already been started for you, so all you need to do is finish cable tying each bundle to about one foot from the end.



Each bundle is labeled with it's destination making it very easy for you to get them headed in the right direction.



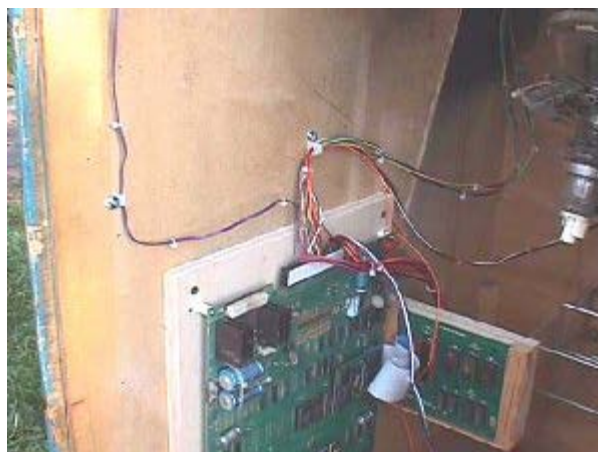
Since colors are repeated on the harness both the coin & start wires are labeled 1 & 2. The reason for labeling both is just a precaution in case one should come off in handling & installation the remaining one would still ID them.



K... cable ties are finished up on all the bundles & it's time to put the harness in the cab. Make sure you put it on with the **Parts Side** facing out. Then layout each bundle in the direction it needs to go.



The control panel bundle up to the CP opening, the coin door bundle out through the open coin door, power bundle heading toward the power supply & the easiest one... the speaker bundle working it's way up to the cab top, or wherever you mounted your speaker.



Since it is the easiest one to run I'm going to start with the speaker bundle mapping out a trail for it to follow & cable clamping it as I go.



A lot of cable clamps are not necessary... just enough to keep the wires firmly in place, although you can use as many as you want, if that's your personal preference.



Crimp on the QDs, plug into the speaker & add one last cable clamp to be sure that the wire does not fall back out of reach.



Above I have placed a couple 3/8" cable clamps over the top of the edge connector to hold the bulk of the harness. I pulled the video cable out first as it will simply free hang over to the monitor & I added the mating Molex to the power wires and clamped them in place.



The video bundle & the isolated monitor feed are shown above free hanging in the general area that they are needed. There isn't a chassis on this monitor, but it's now ready to accept one.

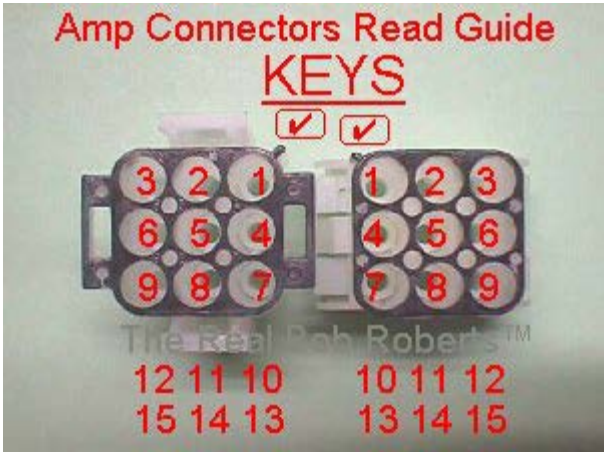
In the pic below you can see that I have measured & cut the control panel bundle where I want the break plug to be, but I have pulled it through the coin door for ease in stripping the wires back & adding the connector before cable clamping it to the cab wall in the control panel area where it will be needed. Note: Be sure to remark at least one of the gray start lines before cutting, so that you can tell which is start 1 & start 2. If you forget it's easy enough to check continuity from one back to the edge connector to identify them.



Another thing you can see in the pic above is the bundle that is simply clamped to the wall. This is the player 2 bundle that is only used in the cocktail table along with the single orange wire that comes from position R on the edge connector. This orange wire is for cocktail table use only & when grounded makes the pic flip upside down for player 2. If you ground it in an upright cab player 2 will have to hang from the ceiling to play :-)



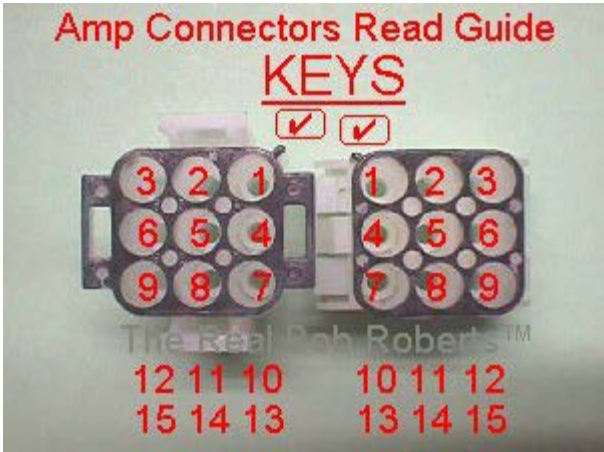
When pinning this control panel break plug you should do so in a manner that will allow you to plug any Ms Pac OEM control panel into it & be fully operational. The Amp connector positions are numbered, but it takes a magnifying glass to read them unless you know the key. I'm going to make up a key read here & give you pin assignments with my harness colors. I'll use a 9 position for the key, but the sequence will continue for 12 or 15 pos.



Position Assignments For Ms Pac Control Panel			
TRBR Color	Pos #	Function	OEM Color
Gray #1	1	P1 Start	Black
Gray #2	2	P2 Start	Black/Yellow
Red	3	Right	Yellow/Red
Yellow	4	Left	Green/White
Blue	5	Up	Tan/Red
Black	6	Ground	Red
NU	7	NU	NU
Green	8	Down	Brown/White
NU	9	NU	NU
NU	10	NU	NU
NU	11	NU	NU
NU	12	NU	NU



Pinning the coin door should be done the same way for retrofitting to any Ms Pac coin door. A short piece of black wire will be needed to jumper from pin 4 to pin 7 in order to ground both positions.



Position Assignments For Ms Pac Coin Door			
TRBR Color	Pos #	Function	OEM Color
NU	1	NU	NU
NU	2	NU	NU
Brown #1	3	Coin 1	Orange/Black
Black	4	Ground	Red
Orange	5	12 Volts	Blue/Yellow
Brown #2	6	Coin 2	Green/Black
Black	7	Ground	Yellow/Green
White	8	Service	Orange/White
Red	9	Credit/Test	Red/Green



Here I've added the protective spiral wrap to encase the coin bundle, harboring it from the mighty jaws of the coin door when being opened & closed.



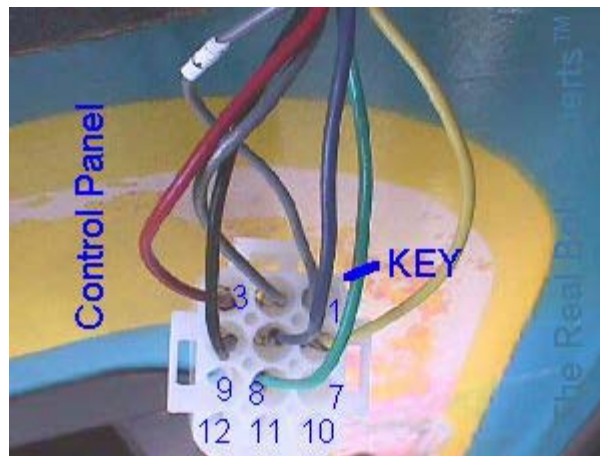
There are several ways of bridging this gap... the connector can be on the coin door & cable tied to the coin mech holder, it can be on the inside wall of the cab with the spiral wrap on the section from the coin door out to the mating plug or you can run straight thru with no break plug. The ideal way is to locate the break plugs as they are in the OEM cab, so that there is never a problem with replacing one section from a dedicated Ms Pac... even if it's only plugging in a control panel from another Pac for test purposes.

You can stick build your harness in the cab... meaning run your wires as far as where you need your break plug, cutting them & then continuing on from the mating receptacle... or you can wire it straight through to completion & then go back & cut & install your break plug connectors where they are needed. Some newbies seem to prefer the latter because they can cut, locate the connector position & complete it thru the connector one color at a time. I guess this is less confusing to some, but I prefer to stick build as I go.

Of course, I suppose if you're pressed for time or simply want the lazy way out, you could wire everything direct & add in a break plug as needed in the future, say when you need to remove the control panel completely :-()

Speaking of pressed for time... I only have a few hours more before Memorial Day (my target for completing this doc) is over & I have 57 of your parts orders to get pulled & packaged for shipping tomorrow, so I'm not going to wire a new control panel or coin door here. I'll leave it with the OEM rat nests that are hooked to both in the pics above and maybe the next holiday will afford me an opportunity to demonstrate a neater way to wire both items.

Alice says that a closeup of the two finished Amp connectors may be helpful, so I've snapped a couple & added them here.



Control Panel



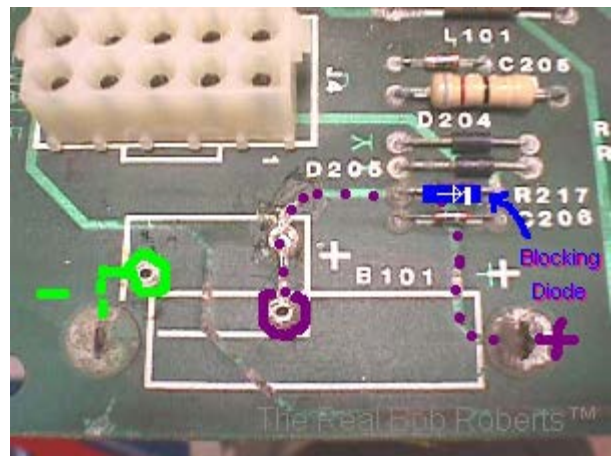
Coin Door

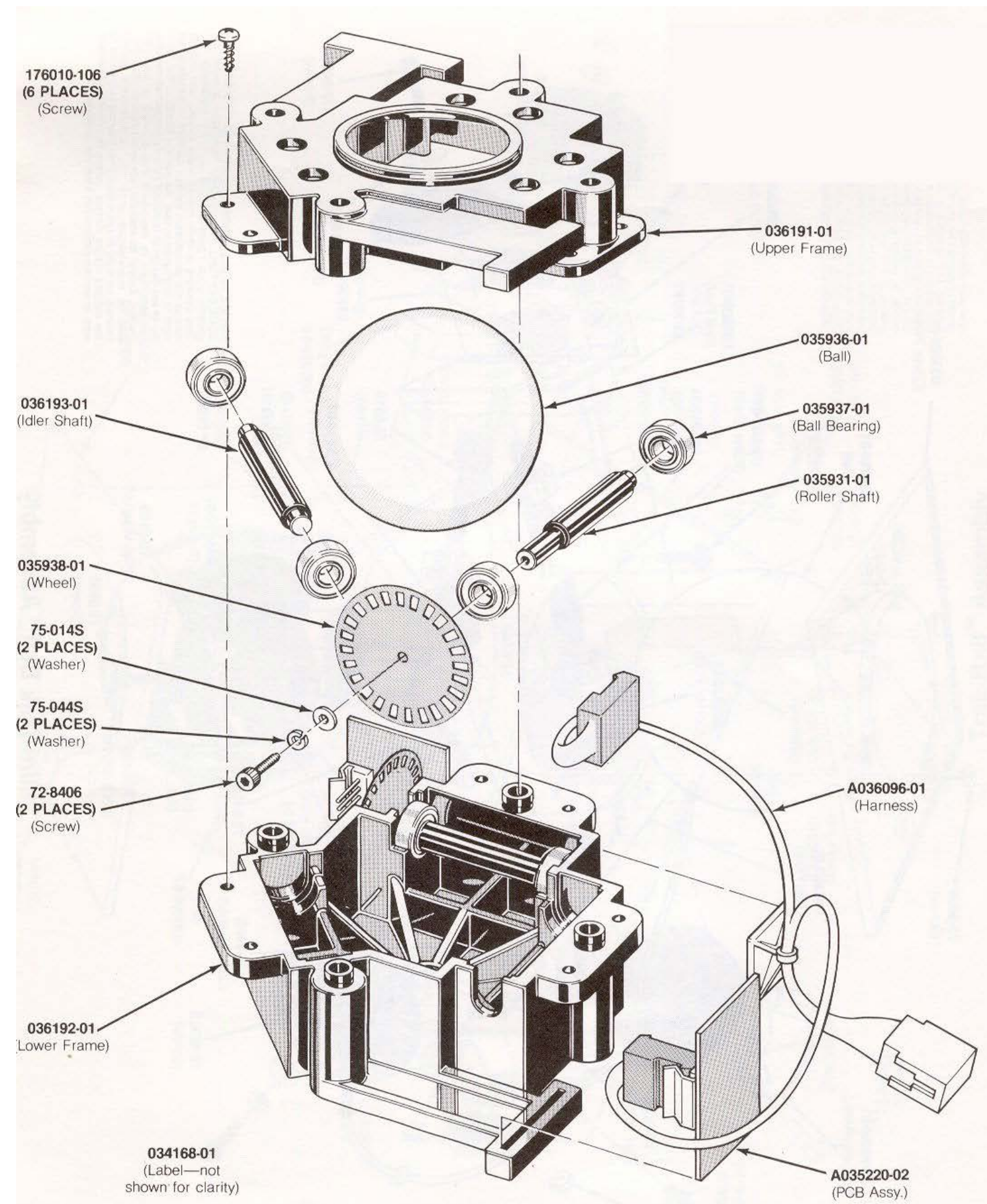
Next Chapter... Hmmmmm ...

Happy Gaming...

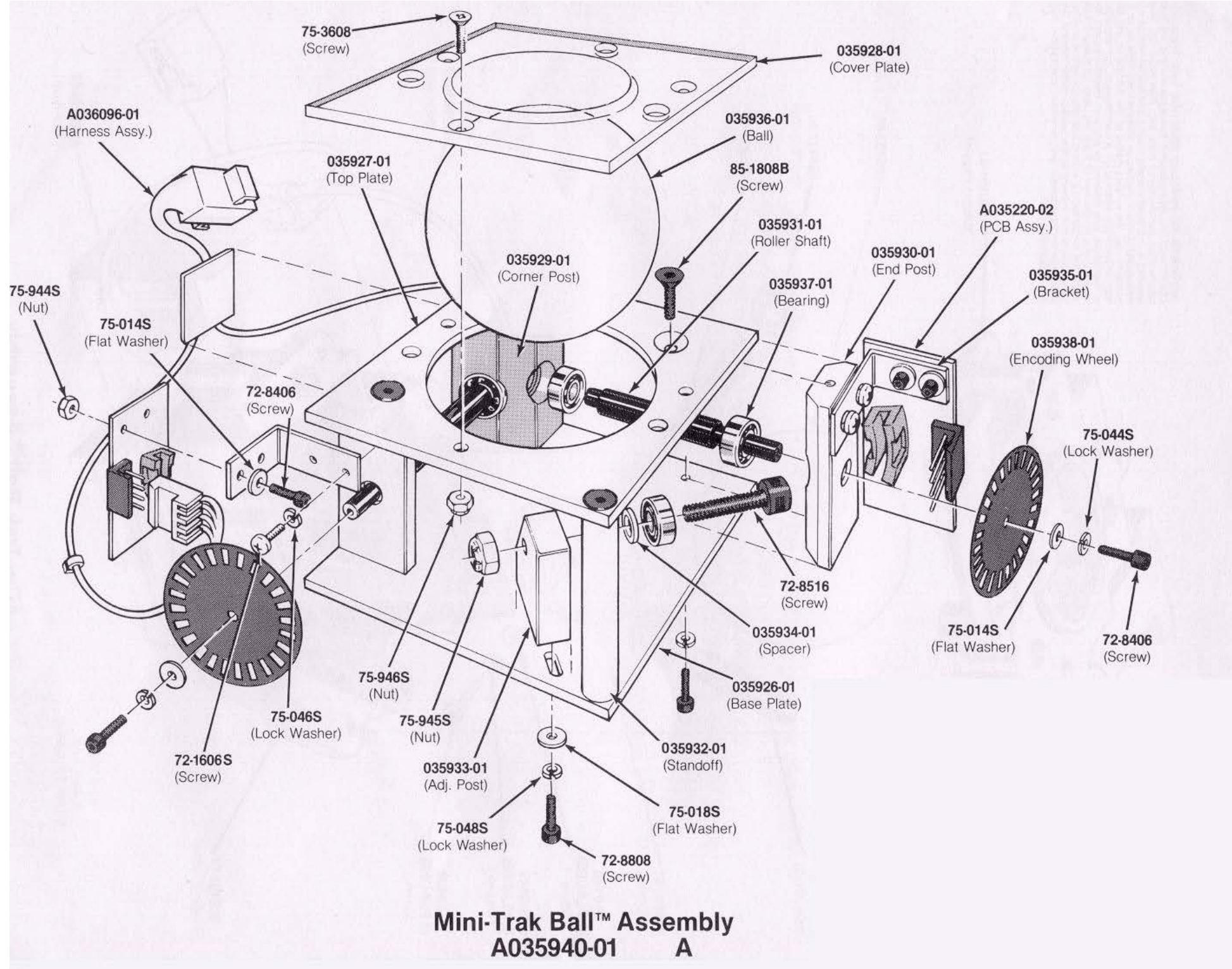
CTS POT CHART
VALUE COLOR

-
- 500 Green
 - 10K White/Cream
 - 250K Violet
 - 1K Yellow
 - 25K Black
 - 500K Brown
 - 2.5KRed
 - 50K Orange
 - 1M Light Blue
 - 5K Blue
 - 100K Gray
 - 2M Pink





Mini-Trak Ball™ Assembly
A036190-01 A



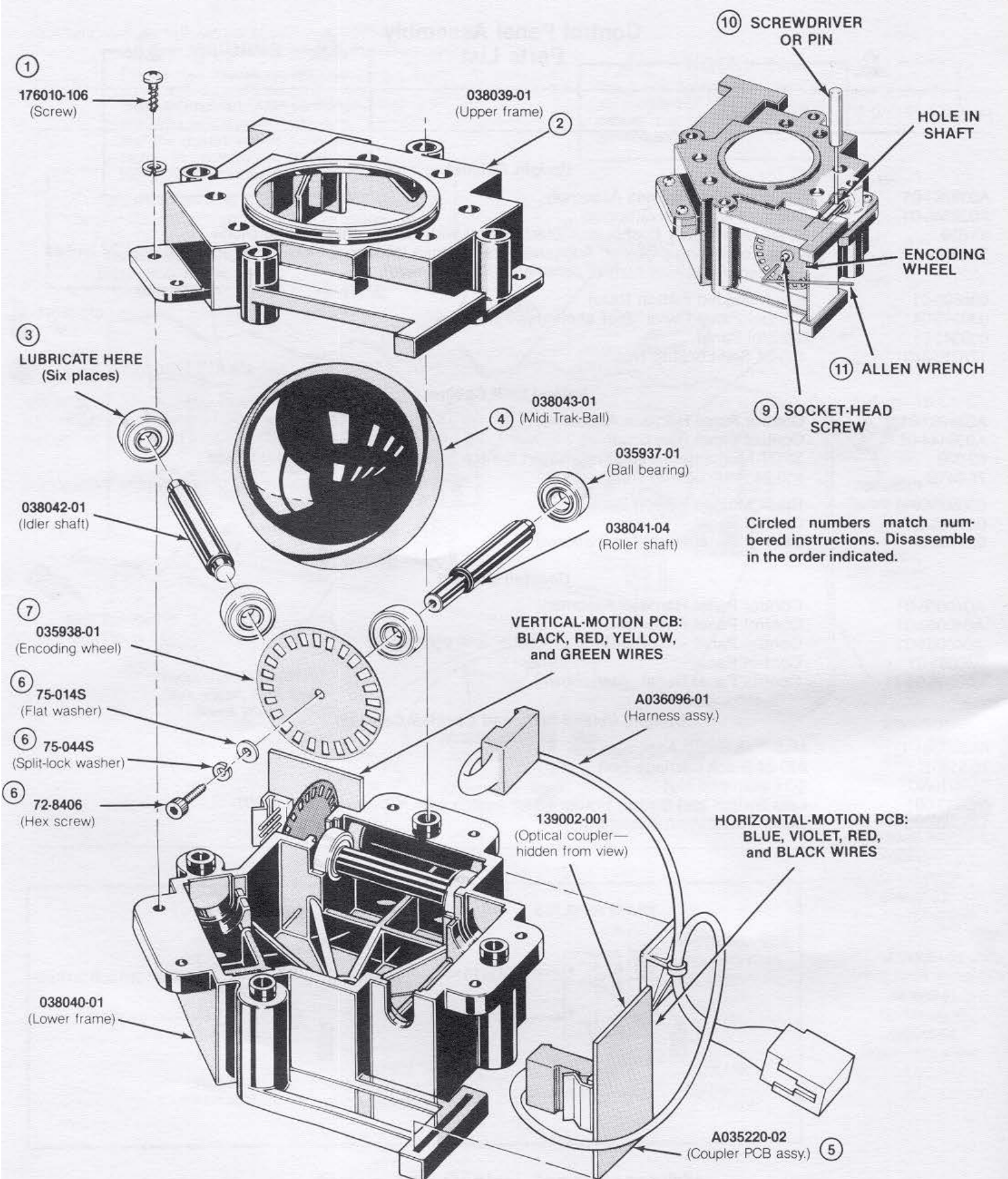
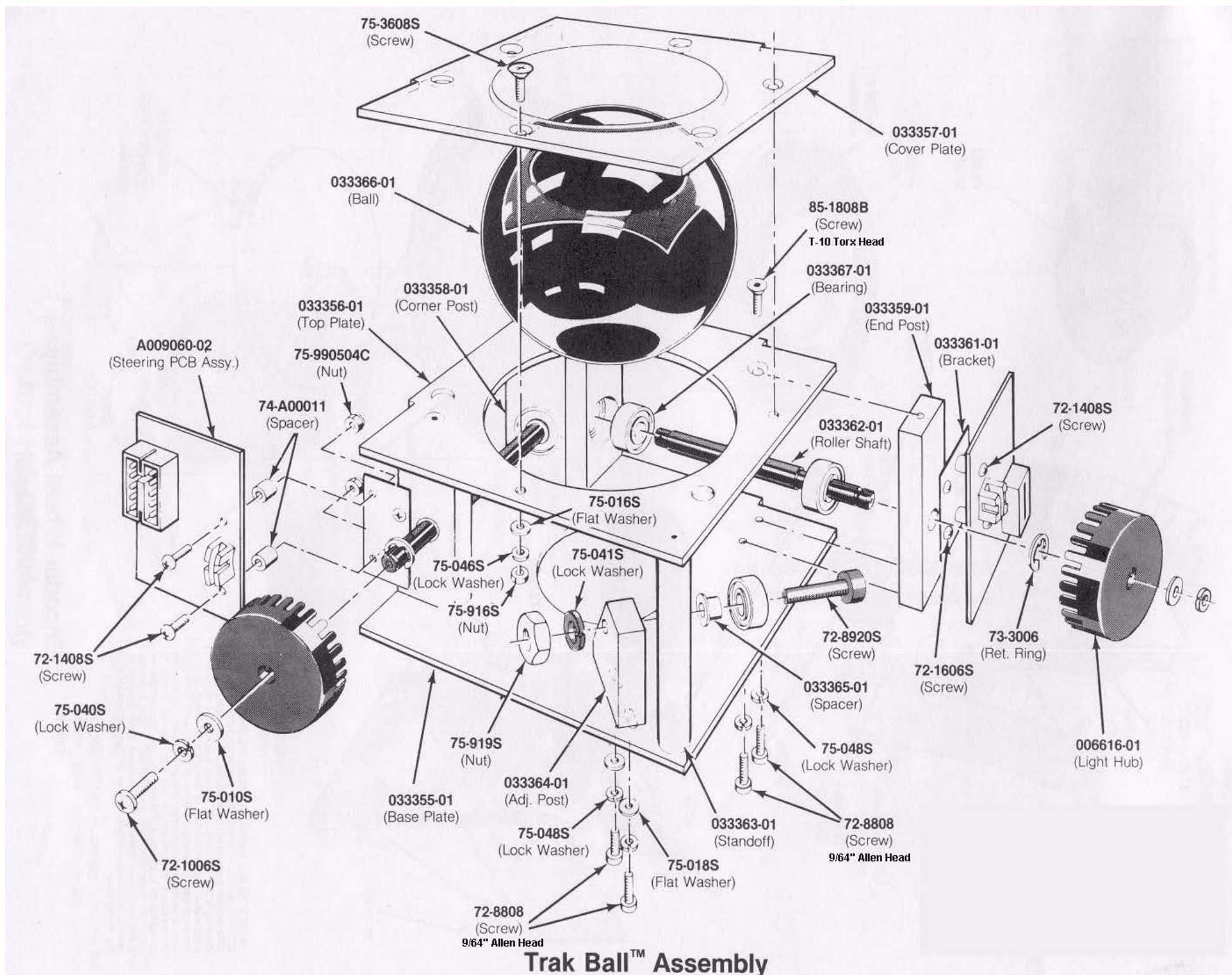


Figure 3-6 Midi Trak-Ball™ Assembly
Δ038039.01 Δ





A033360-01 H

Certificate of Appreciation

THIS CERTIFICATE IS AWARDED TO

"The Real" Bob Roberts

IN RECOGNITION OF YOUR CONTRIBUTIONS, GENEROSITY, TRUST,
ETHICS, AND ENDURING KINDNESS TO:

THE RGVAC ARCADE COLLECTING COMMUNITY

Paul

6/22/07

DATE



PAUL CARROLL, ON BEHALF OF THE COLLECTORS OF
REGGAMES VIDEO ARCADE COLLECTORS



racoon.jpg %d×%d pixels







morris.jpg %d×%d pixels



NEITHER RAIN NOR SLEET?

The storm has passed, the cleanup is under way and local residents want at least one piece of their normal, pre-Katrina lives back: their mail!

Wednesday, November 23, 2005

By Michelle Hunter
East Jefferson bureau

Arthur Zatarain knows his mail is out there somewhere.
Problem is, it just hasn't been in the mailbox at his Old Metairie home.

"It's somewhere in the bowels of an Indiana Jones-style warehouse, probably beneath a mountain in Montana," joked Zatarain, who said he is genetically but not financially linked to the popular Cajun spice empire of the same name.

He and his wife, Georgette, had their mail forwarded to Lafayette shortly after the storm. The first piece of forwarded mail arrived Nov. 10, weeks after they had already returned to Metairie from evacuation. But little else has reached their mailbox, including a document they've been waiting for from their mortgage company showing their house was paid off just a week before Hurricane Katrina hit. They want that paperwork.

"It's so screwed up," Zatarain said. "But it's the uncertainty that's killing us. They can't give us a straight answer on where the mail is."

The Zatarains are feeling the postal pain shared by many in the New Orleans area since Katrina made landfall. And with the holiday season approaching, the concern about mail service is likely to heighten. U.S. Postal Service letter carriers are making street deliveries in Jefferson Parish and some portions of Orleans and St. Tammany parishes. Residents of other hard-hit areas can pick up mail at alternative sites set up by the postal service.

But some residents and businesses report letters and packages sometimes taking weeks instead of days to arrive. Postal officials said carriers are doing the best they can and could not say how long it now takes, on average, for mail to be delivered in New Orleans. But a Times-Picayune postal test tracking letters sent to New Orleans addresses revealed delivery times of up to two weeks.

Post office officials say that's because of damage at several post offices, including the state's largest mail processing plant located in New Orleans. Despite that, and the personal losses suffered by employees, the men and women of the USPS have been working hard to restore service, and delivery waits should only shorten in the future, officials said.

Survey says

In the last week of October, six Times-Picayune employees living in various parts of the New Orleans area mailed letters to one another. Each person also received two more letters, one mailed from Georgia, the other from New York.

It took one letter mailed from the French Quarter to a residence in Mandeville just two days to arrive. But a letter from Mandeville to the French Quarter took eight days, and it took at least six days for the others mailed to local addresses. Out-of-state mail, especially letters sent from Georgia, seemed to take longer. One letter mailed to Terrytown from Georgia arrived after 14 days.

Postal Service spokeswoman Darla Stafford said the reason for the extended delivery times is the circuitous journey New Orleans-bound mail now has to take since Katrina took out the state's main mail processing plant. And with Christmas just a month away, she urged residents to plan ahead and mail earlier than they normally would.

Before the storm, the New Orleans plant, at 701 Loyola Ave., processed 6 million to 8 million letters for Jefferson, Orleans, Plaquemines, St. Bernard, St. Charles and St. Tammany parishes, as well as for parts of Mississippi and Alabama, post office officials have said.

But floodwaters destroyed the electronic equipment stored in the basement, reaching the first floor and leaving the facility unusable, Stafford said. Instead of the one-stop shop at the New Orleans plant, a letter mailed across town now must travel to Baton Rouge for a postmark, then to Houston to check for forwarding addresses, back to Baton Rouge, then on to St. Rose to be sorted for delivery and back to the appropriate local post office, Stafford said.

"We apologize for any delays," she said, "We hope the people understand that we've got a lot of logistical challenges that we didn't have before. But we are getting better every day."

Until two weeks ago, mail sorting was done in Beaumont, Texas, said postal Service spokesman Dave Lewin. But now it's done in the recently reopened St. Rose mail facility on Airline Drive, letting officials shave a day or two off the trip. In Houston, the mail is run through a computer that checks for the most recent change-of-address order. Within the next four weeks, officials hope to install a similar system in Baton Rouge, cutting more time.

Local bypass

But speeding up the mail will take time. The slow pace of delivery is affecting more than just residents. Some businesses that have relied on the Postal Service are now making other arrangements.

Mpress, a commercial printing and mailing company in Kenner, has taken to trucking its mail to a post office in Jackson, Miss., said Ron Stewart, vice president of marketing. The post office there takes care of checking forwarding orders, he said, eliminating the trip to Houston and saving a couple of days.

Ben Bagert, attorney with the Bagert Law Firm in New Orleans, said his employees have turned to overnight delivery services and the Internet. They've had to become savvy in scanning documents as electronic files and e-mailing them to clients, he said.

"The mail is just not as reliable as it was before the storm," Bagert said. "We're figuring ways around it. We're not casting blame or aspersions. We understand what it's like to be shorthanded."

Before Katrina, Bagert said, his firm received about 70 pieces of mail a day, including unsolicited junk mail. Now that's down to about 20 pieces. And he's not alone. Others say there just seems to be less mail, as if some of it is missing.

Stewart said some clients reported they never received some mail that Mpress sent out before the company starting trucking its mail to Jackson. Many residents, like Zatarain, say the volume is down.

Lewin said that's correct, because roughly less than half of the usual volume is now coming in. That is due in part to a ban on advertising and periodicals. Since Katrina, only first class mail -- letters, bills, cards, parcels and packages -- have been given delivery priority over mail such as advertisements, credit card solicitations, magazines and catalogs, Lewin said. That mail usually makes up about 50 percent of the mail handled, he said.

The ban is still in effect for all of Orleans Parish, and portions of St. Bernard and Plaquemines parishes. Lewin could not say when the ban would be lifted, but postal officials said it could be early next year.

Some of the missing mail could be the advertisements and magazines most people are used to receiving, Stafford said. But some could be first-class mail that is not forwarded at the mailer's request. Some mailers, for example, a few financial institutions, have do-not-forward orders. The mailer may have asked the post office to notify them of any change-of-address. Credit cards, for example, are never forwarded to a new address, Stafford said.

Taking steps

If any resident or business is concerned about missing mail, Stafford suggested contacting the Postal Service help line to make sure all change-of-address orders are correct. Stafford recommended contacting the mailer in all cases just to check on the item sent and make sure there were no changes to mailing procedures. Stafford also encouraged residents to stop by their local

post office to notify their carrier that they are back, if they have not done so already.

And though some residents may wonder if mail from the days and weeks after Katrina was stored somewhere, both Stafford and Lewin said that is not the case. Most of the mail in post offices the weekend before Katrina hit was delivered on the Saturday before the storm. Most of what was left over was trucked out of the area. A small amount of mail at the New Orleans plant was damaged, Lewin said, some beyond recognition. But a large portion of that was not first-class mail, he said.

Another issue for the Postal Service is similar to the challenges facing most local businesses, Stafford said. While many Postal Service employees are back at work despite suffering personal tragedies during and after the storm, some have not returned to the area. But the post office has made mail service a priority. The mail is flowing, she said.

"I apologize for any frustration the customers are having," Stafford said. "But we're delivering to people. It just takes a little bit longer because of the logistical issues."

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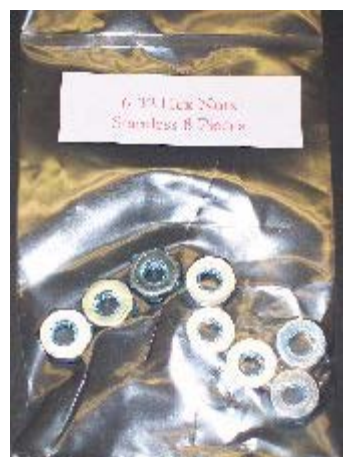


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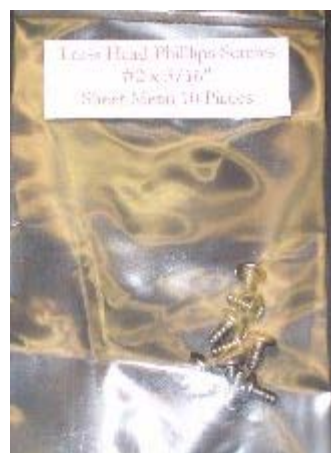




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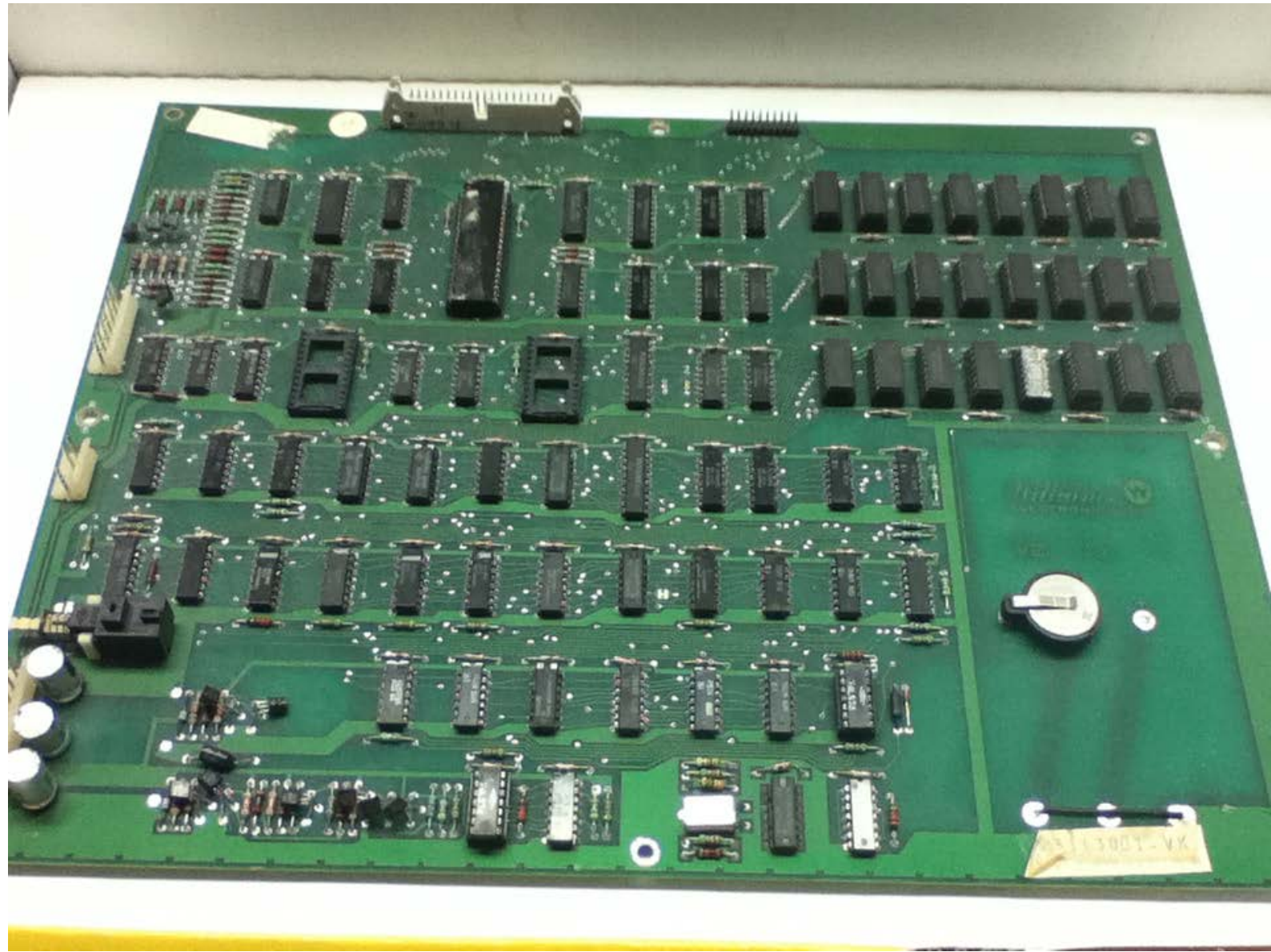


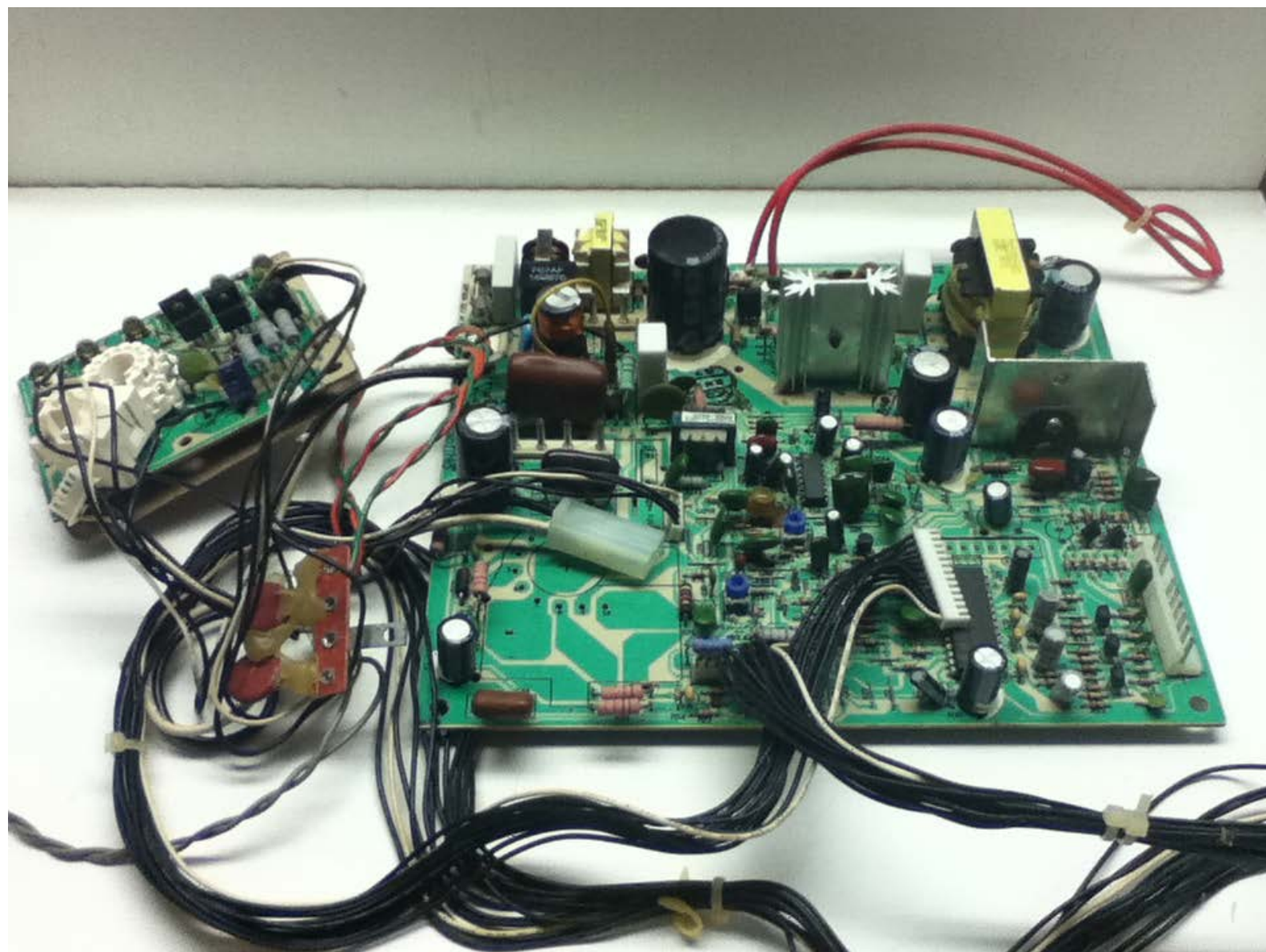


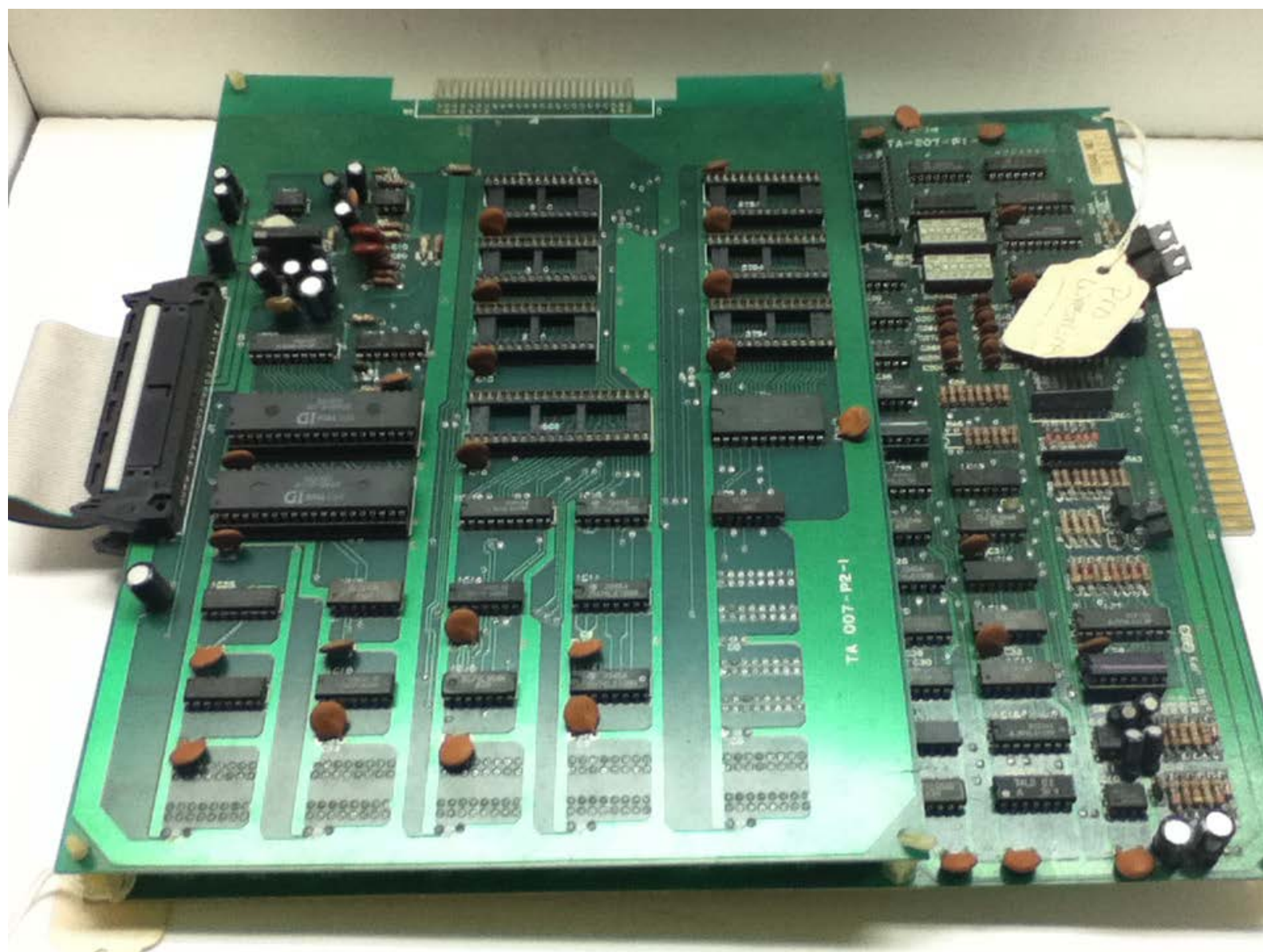


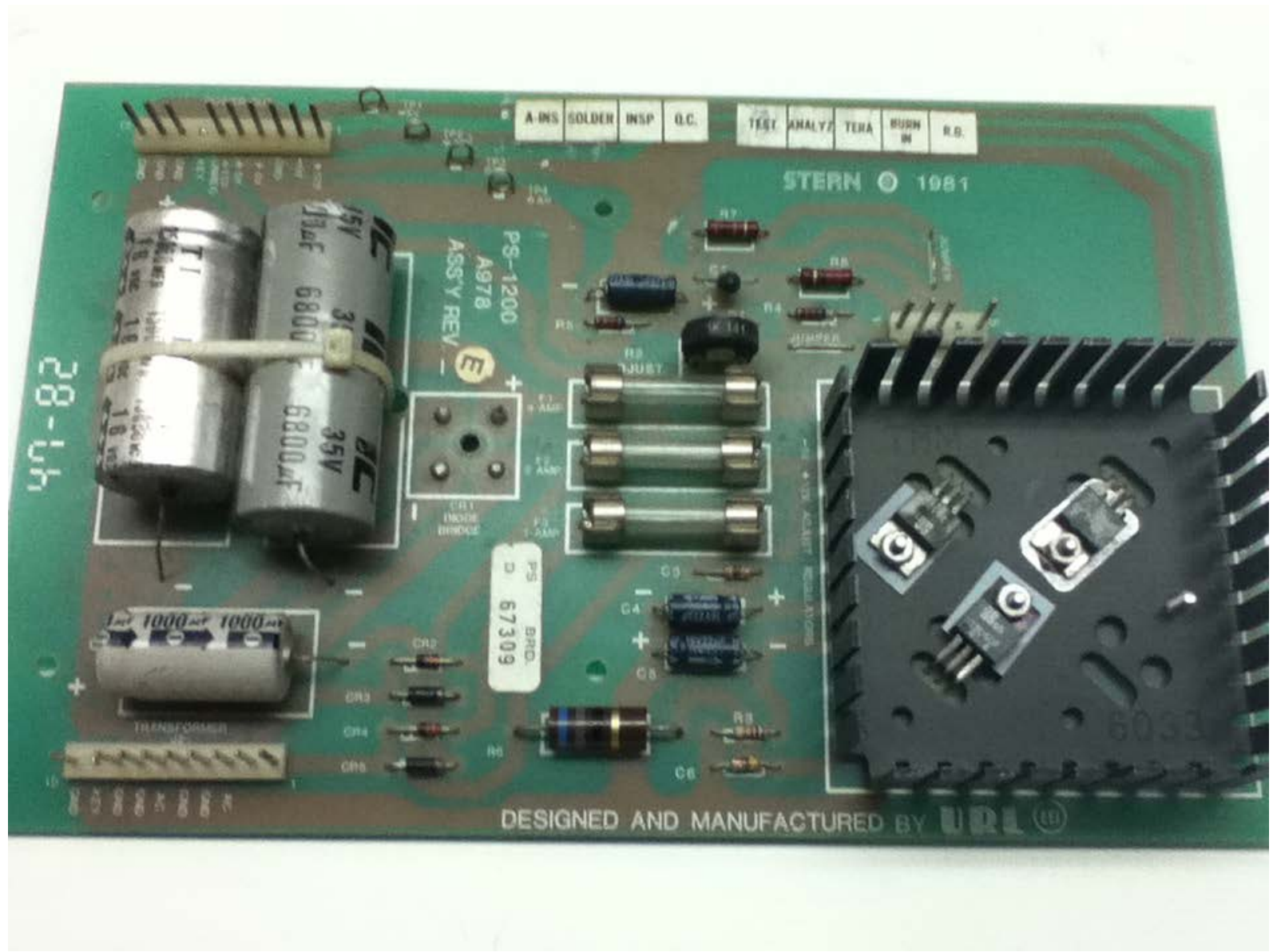




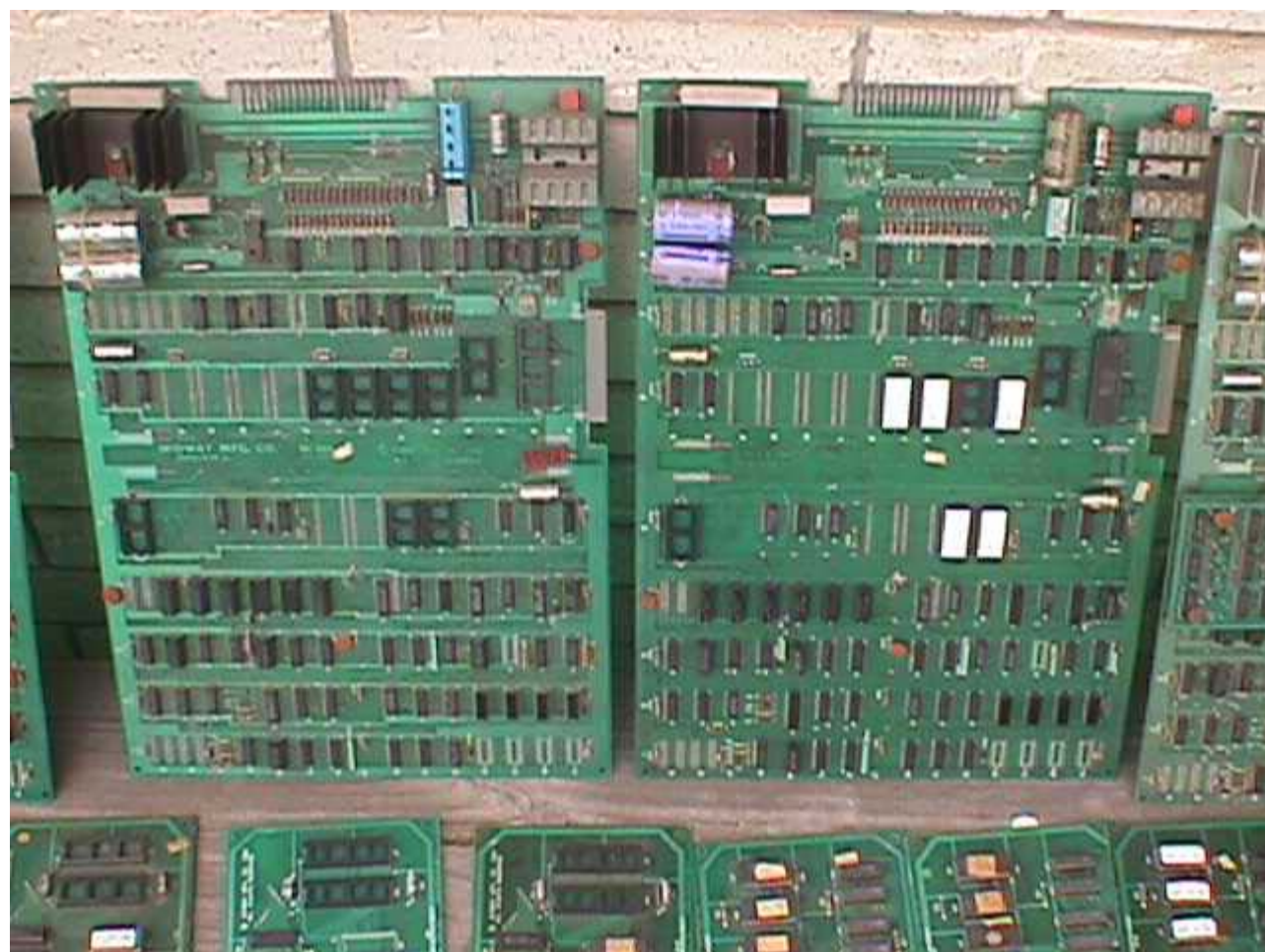




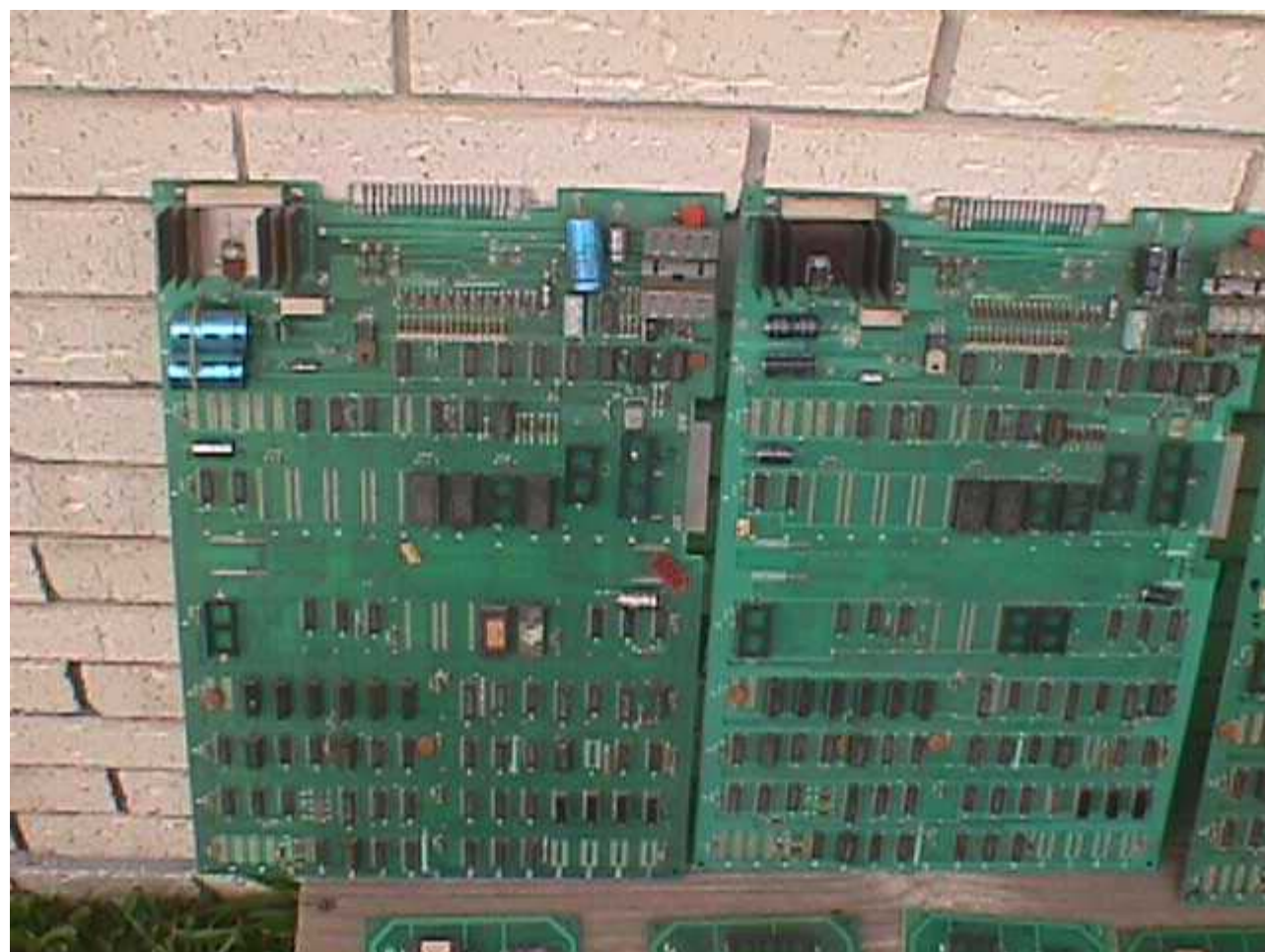


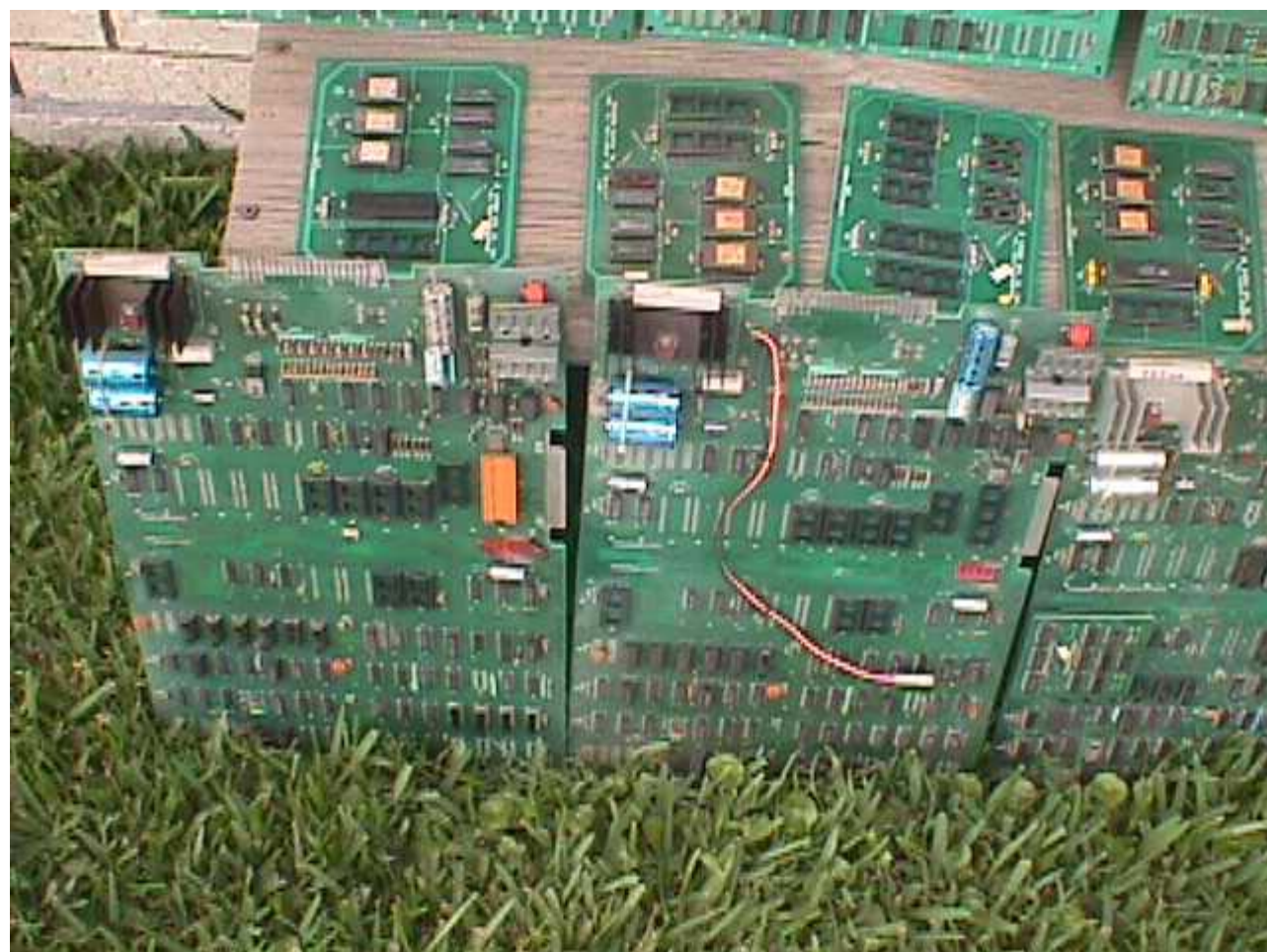


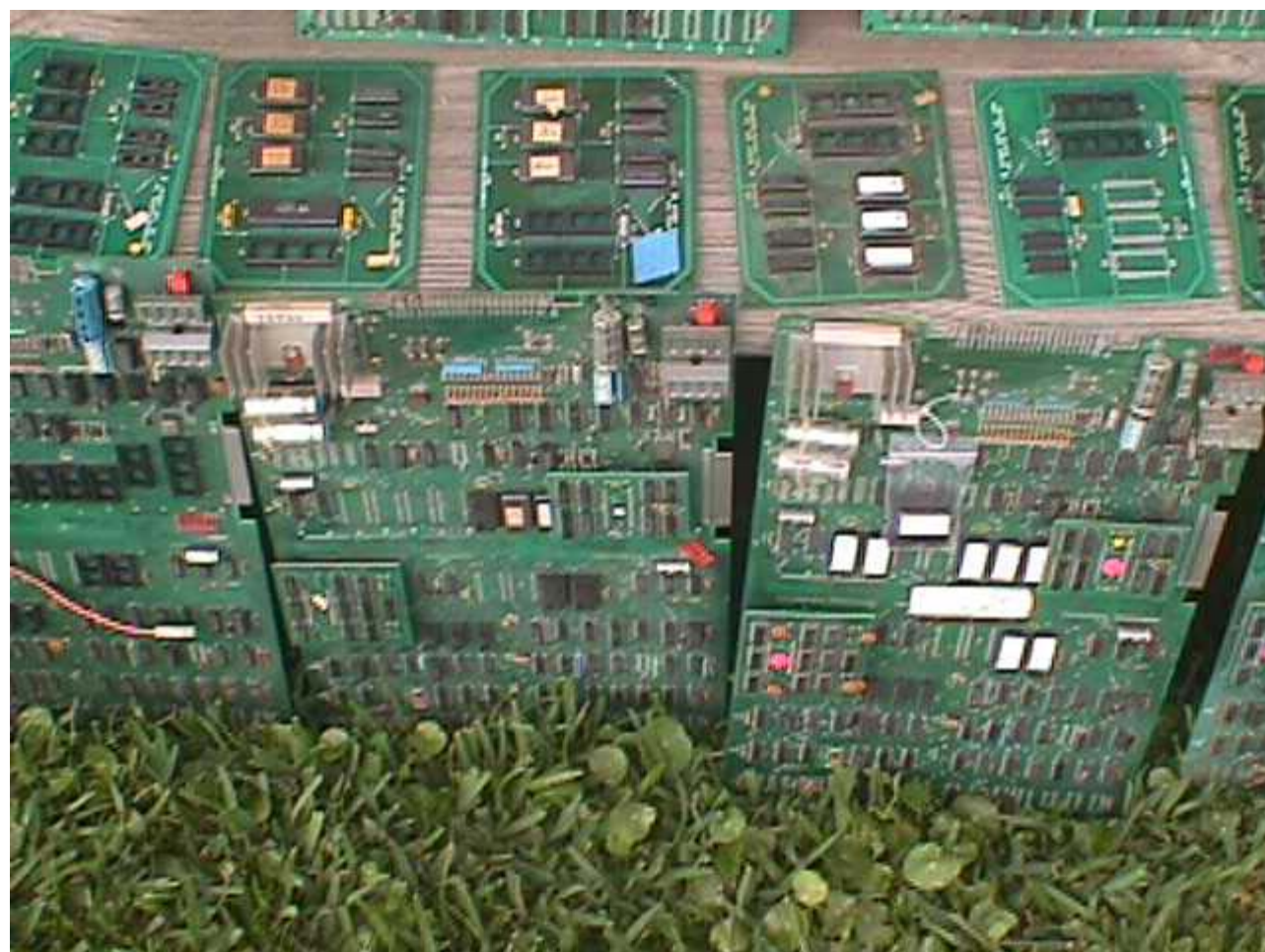


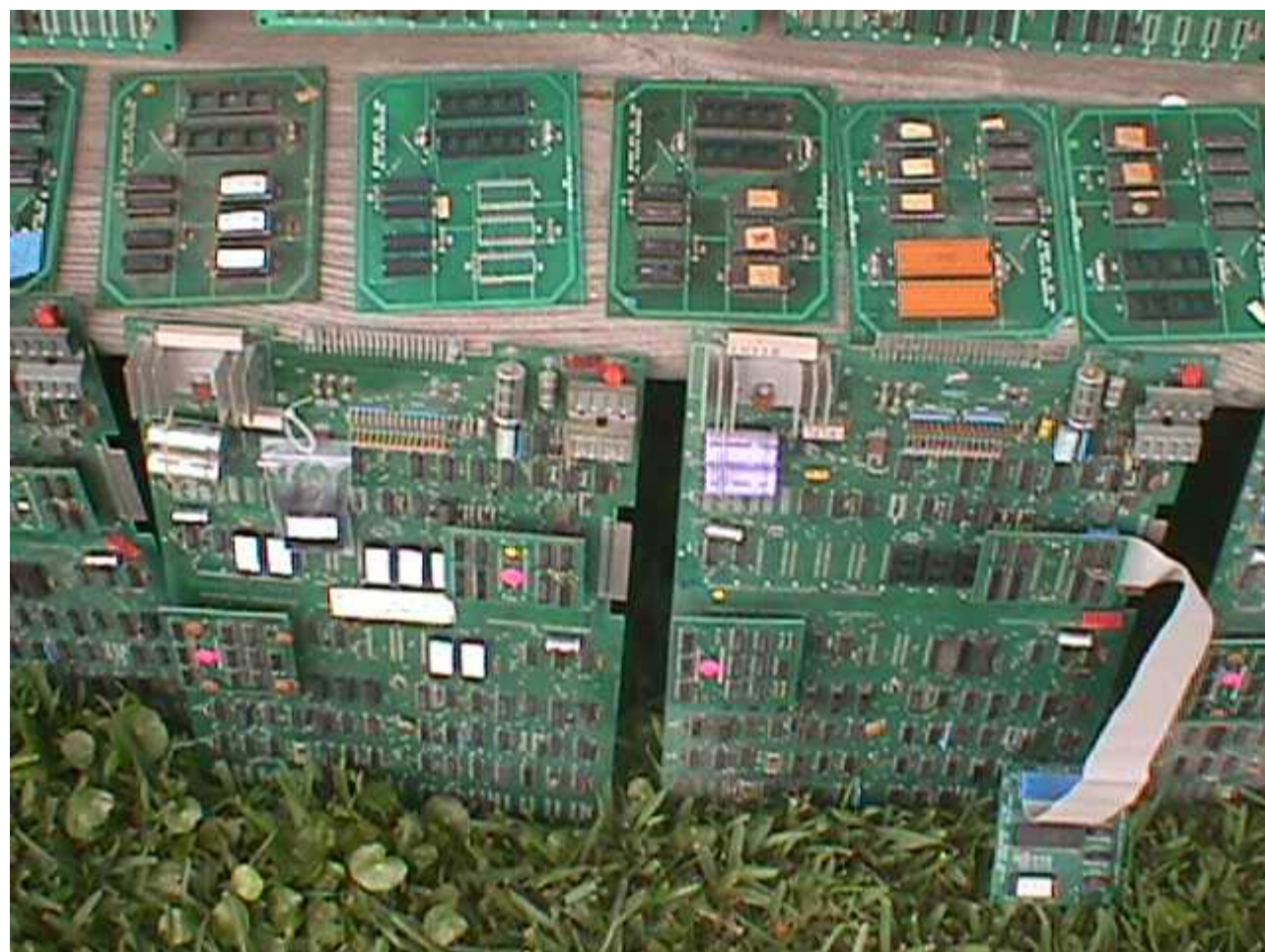


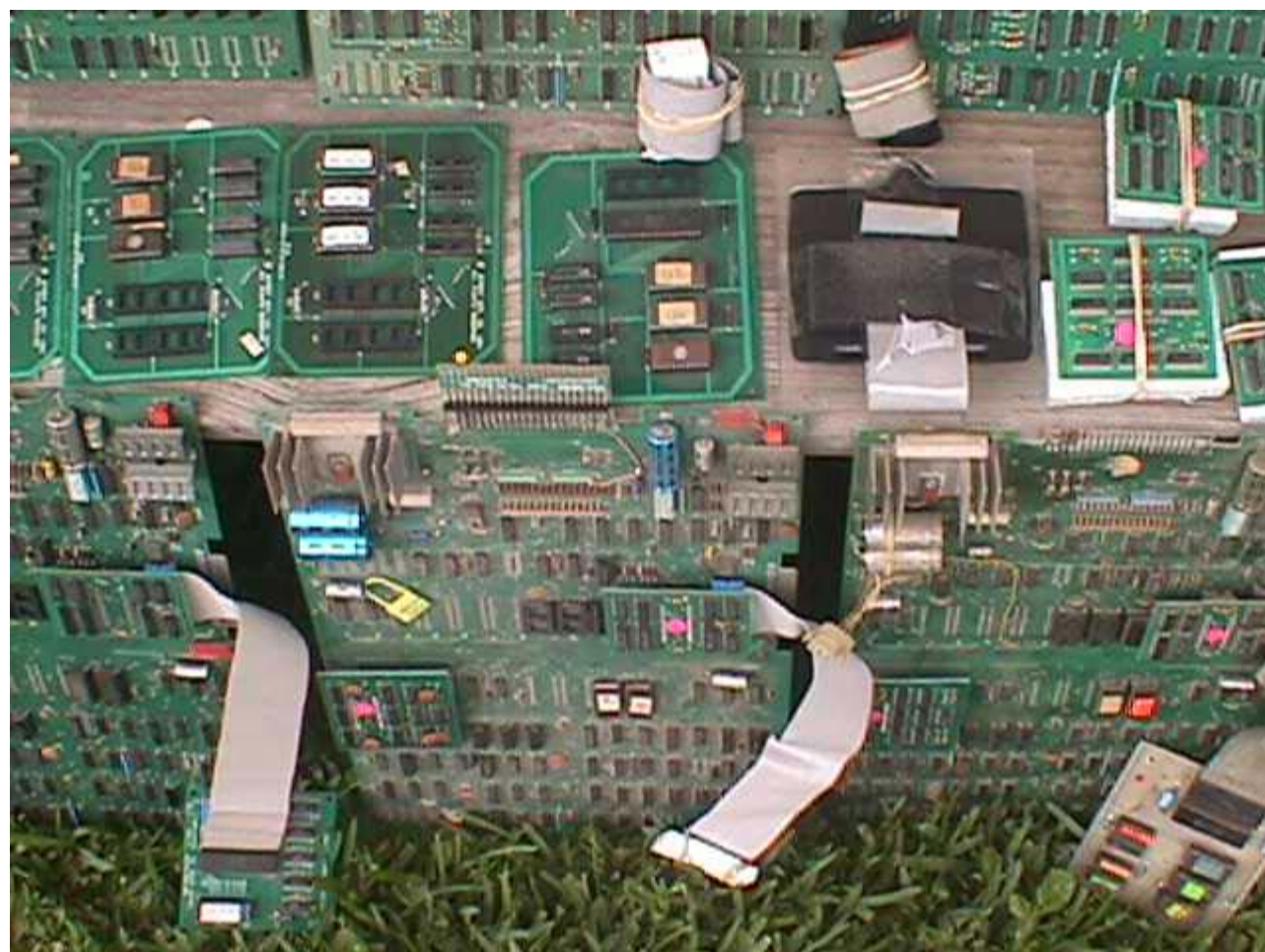




















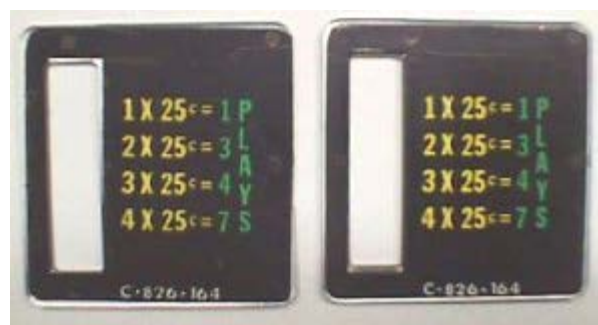












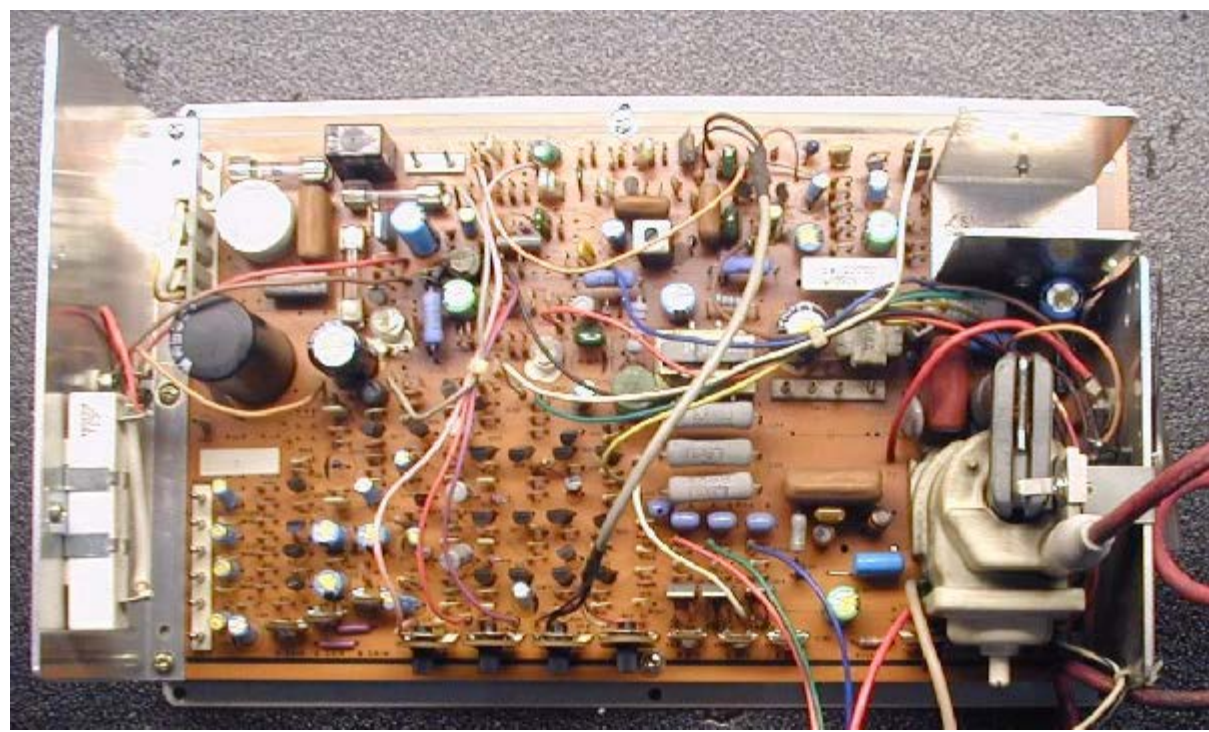






To return to K4600 click pic





If you guessed a Wells Gardner K7000 cap kit you'd be right. It's the old K7000 chassis that had such a good track record. Caps & other passive components appear to be marked the same as WG's chassis & I would not be surprised if the flyback wasn't also compatible with the WG 053X0528001. If it is, it looks like this SI chassis may be around for a long time to come.